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TELEGRAPH RATES ON THE EAST COAST OF AFRICA.

WE understand that a meeting of the representatives of the various South African Governments was held in London recently, with the object of obtaining a reduction of the present high rate to South Africa. The tariff is at present 8s. 11d. per word, and it is hoped that by arrangement this amount may be reduced to 5s. per word. We learn that Sir James Sivewright, whose long experience of telegraph matters, both in England and Cape Colony, thoroughly qualifies him for the work he has undertaken, is at present negotiating with the Transvaal Government concerning the proposed reduction, and appears to anticipate a successful issue. South Africa is fortunately in the position of being served by two distinct lines of cable: one on the West Coast, the other running along the East Coast of Africa. It is to the latter of these that we should more particularly direct our attention. The service on the East Coast is carried on by the Eastern and South African Telegraph Company, almost the whole of the share capital of which company is held by the Eastern Telegraph Company, and the cables of these companies join each other at Aden, from whence telegrams from Africa for Europe pass over the lines owned by the latter company. From figures given in the Stock Exchange Year Book, it is evident that the Eastern and South African Company have been reaping a large profit on their share capital of £600,000, the amounts distributed for the last few years being as follows:—Year 1886-87, 10 per cent.; 1887-88, 12 per cent.; 1888-89, 19½ per cent.; 1889-90, 18 per cent.; 1890-91, 10 per cent.; 1891-92, 10 per cent.; and for each of the two following years 8 per cent. From the above it will be seen that this company is in a position to make considerable reductions in its rates; a reduction which would doubtless have the effect of increasing the volume of traffic. In considering this question, it must not be forgotten that this company was able to raise £550,000 in 5 per cent. mortgage debentures, secured upon subsidies amounting to £60,000 per annum, guaranteed for 20 years from 1879 by the English, Cape of Good Hope, Natal, and Portuguese Governments, in respect of the Aden and Natal lines; and also upon the revenues arising from these lines. At present, the company has the whip hand of its customers; the subsidy above referred to has still about five years to run, and the southern sections of the lines along the *West* Coast of Africa are also in this company's hands. By this prudent arrangement there is no present possibility of competition; and thus, in return for a reduction of rates, the Eastern and South African Company will possibly be able to exact an extension of their present privileges; this we hope, however, may be so arranged as not to prevent free competition in the future. As far as the rates themselves are concerned, there is a good deal to

complain of from the public point of view. The cost of a telegram from London to Natal, which passes over 8,700 miles of cable, some 3,900 miles of which is subsidised at the rate of £60,000 per annum, is 8s. 9d. per word; whereas, for comparison, a telegram from London to Rangoon, passes over some 6,700 miles of cable and 2,000 miles of landline, a total distance of about 8,700 miles, unsubsidised, and the charge per word is only 4s. 2d. Again, from London to Adelaide, a total length of about 13,000 miles, the charge per word is only 4s. 9d.; in the latter case, however, a portion of the line is assisted by subsidy.

Touching the efficiency of the service, it would be well, in coming to any arrangement, to bear in mind that since September 26th last, three of the cables on the direct route between Aden and Natal have broken down. The particulars are as follows:—One of the two cables between Zanzibar and Mozambique, interrupted from September 26th, 1894, until 22nd of last month. The only cable between Delagoa Bay and Natal, interrupted from the 10th till the 22nd of last December. The only cable between Aden and Zanzibar interrupted from December 21st till the 10th of last month. The cable which runs from Zanzibar to Mombassa, and which was interrupted from September 4th until November 28th last, is not in the direct route from Aden to Natal.

In the negotiations for the desired reduction of rates, we have not heard that Mauritius is taking any active part. The cable which connects this island (and the Seychelles) with Zanzibar, is owned by the Eastern and South African Telegraph Company, who receive from H. M. Government, on account of this line, a subsidy at the rate of £28,000 per annum, to be paid for the 20 years following 1893.

Although the company draws, as above pointed out, Government subsidies at the rate of £88,000 per annum, still the rate per word for a telegram from London to Mauritius, a cable distance of about 8,900 miles, is maintained at 8s. 9d. per word.

In conclusion, we hope that some arrangement will be come to regarding these rates, by which, without delivering themselves bound hand and foot to the company, the South African States may be able to obtain such a reduction of the present excessive tariff as will admit of a freer public use of this heavily subsidised line.

The Heating Power of Smoke.

On February 8th we published a letter from Mr. Tatlock taking exception to our comments of January 18th upon his pamphlet entitled as above. Anyone reading his letter would imagine that we had contradicted his statement that black smoke in itself had little heating power. Now, we did nothing of the sort; we very clearly emphasised Mr. Tatlock's conclusion, but we did and do quarrel with the acceptance of Playfair as an authority on the power of coal, and as Mr. Tatlock asks for further authority let him apply to the Manchester Steam Users Association. He now, however, begs the question as to tar. We did not say that tar was produced in a boiler furnace. What we did do was to state that Mr. Tatlock was wrong in giving the evaporative power of tar or gas as less than one-fourth that of carbon. It was Mr. Tatlock himself who spoke of the amount of tar to be got from so much dross and who then went on to decry the calorific power of such tar, and now he quarrels with us for even naming tar. Now, smoke is due to insufficient temperature and too much or too little air, and if a furnace be altered to use more nearly a proper supply of air and secure a higher temperature at the locus of combustion, smoke will be prevented and economy secured—not by utilising the smoke as a combustible, but by reducing other losses, as for example, the loss due to heating up an excess of air, and we referred to a means of doing this which Mr. Tatlock entirely overlooks in his anxiety to fasten on us statements as to tar production that we never made. We really must refer him to what we did say on January 18th. He may then see how wrong he is to attempt to fasten upon us a charge of assuming that a boiler furnace behaves the same as a gas retort. What, however, did he mean when he stated the evaporative power of tar and gas as only 3·1 pounds of water? Yet he now says he is willing to accept Mr. Holden's estimates, or, rather, facts. We are confronted with the Glasgow and West of Scotland Smoke Abatement Association. The writer had occasion to write to this Association, giving the address as Glasgow. The letter came back *via* the dead letter office, so the writer has been unable to see the report of this Association.

Niagara Electrical Distribution Scheme.

It seems that the Niagara authorities are not so liberal in parting with information as were the engineers upon whom they relied at the outset for obtaining knowledge and plans gratis; for although one, at least, of the large alternators is completed, an American writer in *Electric Power* expressly states that "the company does not care to permit the plans to be made public." In that case the writer may safely make his sweeping statements that "the machine is an entire departure from any heretofore designed, first in having fields revolving outside the armature, second, in the low frequency, and, third, in the working a horizontal armature on a vertical shaft." Now, as the construction of the actually completed machine is at present, for some reasons, carefully concealed, we cannot say whether or not it is "an entire departure from any heretofore designed," but we can assert that none of the features cited were new to European electricians at the date of the design of the dynamos. Alternators with outside revolving fields had been made by C. E. L. Brown, and vertical shafts had also been used. Then, as for the low frequency there was absolute indifference on that point, and it certainly is not yet proved that the frequency adopted at Niagara is the best. When the construction is revealed we shall be able to see for ourselves and present our views on the novel points therein—if there are any. Considering the alternators have been built by the Westinghouse Electric Company, we have not the slightest doubt of their perfect success, more especially as their own engineers had a free hand to alter the orginal designs to meet the exigencies of practice. But looking back to the history of the scheme, and the proceedings after the meetings of the famous "commission," we think the less said the better about the unfortunate twenty or so builders and designers of electrical plant who guilelessly submitted their plans and experience, only to be rejected. We have heard enough of the historical side, we are now awaiting the arrival of some reliable details as to the performance of the alternators in whose design and construction so many men have had a hand.

Difficulties of Some Definitions.

Two difficulties, which all who have had anything to do with trying to instil electrical notions into the average brain are familiar with, have recently been the subject of communication to the American scientific periodicals; we refer to the dimensional difficulties in defining magnetic potential, and the production of an E.M.F. by change of induction. It seems that even the American schools, many and good as they are, have not always been able to instil into their students the fact that *whenever* a change of induction occurs in any circuit, there is an E.M.F. produced, the current being merely a secondary phenomenon depending on whether the circuit is closed or possesses capacity. The first point is one which always crops up when one tries to explain the two systems of units, and Mr. Bedell (in his brief communication to the American *Physical Review*) has very clearly pointed out the cause of the discrepancy. The difficulty will always occur while μ and κ are defined as constants, and not as the ratios of the measures of certain properties in free ether to their measures in matter.

DIOPTRIC GLASS SHADES AND HOLOPHANE GLOBES.

By André Blondel.

I have only just become acquainted with the interesting article by Mr. A. P. Trotter, published in the Electrical Review for December 14th, on "Dioptric Glass Shades," in which he compares the system that I have recently brought out jointly with M. Psaroudaki, with that invented by himself in 1882. Mr. Trotter's remarks are so kindly expressed, that I must take this opportunity of thanking him for the interest he shows in our system. Moreover, I had myself acquainted him with its recent applications long before they were described in the French journals. From the first I have endeavoured to pay him full justice by reminding of his praiseworthy labours, especially when, two years ago, I explained our first attempts before the French Physical Society.*

I am happy to have given Mr. Trotter an opportunity of describing his researches, and I hope that I may be allowed in my turn to complete his description by giving the history of our own labours, and showing the differences that exist between Mr. Trotter's system and ours. These differences must be of some importance, for, although Mr. Trotter was refused a patent by the German Patent Office, we were granted one in virtue of the principle of our invention.

The first object of the researches that I undertook together with M. Psaroudaki, in 1892, was the construction of a crystal or glass globe, which would allow of the diffusion of the light without the losses entailed by the use of opal globes.

We tried first a process very different to Mr. Trotter's, and which consisted in imparting to the outer surface of the globe a number of little lenticular hollows; then we used at the same time a crossed groove arrangement.

We succeeded by both these methods in obtaining a certain diffusion, at the same time sending the light below the horizon. But we soon gave up the employment of these little cavities on account of several inconveniences, but above all, the difficulties involved in the manufacture of globes of this kind. Moreover, the German Patent Office refused the whole of that part of our patent relating to this process, because a German inventor had already patented an analogous system, having cavities on the inside of the globe (a system which it was, however, impossible to carry out practically).

In 1893, while we were pursuing our researches on the double grooves, we learnt that dioptric shades had already been constructed according to this principle by Mr. Trotter in 1882; and shortly afterwards† M. Raffard, engineer to the Breguet firm, claimed the priority of this idea, which he had in fact applied in 1878-79 to lighting the Port du Hâvre, by means of lanterns furnished with double glasses grooved perpendicularly. We know that, as Mr. Trotter says, the idea of employing shades with double flutings for diffusing light is very old; perhaps even another inventor might be found before M. Raffard. I am not speaking of M. Frédureau's system of single grooves, because, unlike those in question, it has no scientific value, and loses as much light as an opal globe.

Whatever value there may be in these claims to priority, they have not discouraged us from continuing our researches, as we could see at once that neither M. Raffard nor Mr. Trotter had attained the result at which we aimed: neither of them had constructed globes; their lanterns were formed of flat pieces of glass; Mr. Trotter's cylindro-spherical screens for incandescence lamps, which I have had in my hands, are bright only over a small portion of their surface, and from 25 to 35 per cent. of the light is lost through inside reflections, which are not generally noted for want of photometric measurements. We, on the contrary, wished to make a *spherical globe* of crystal, which should be luminous over the whole of its surface, and which should not waste more than 10 to 15 per cent. of the light. We did not arrive at this result until after several series of experiments, which occupied three years of uninterrupted work, during which we modified the form of the flutings, the indices of refraction, the modes of construction of the moulds, &c. This shows that our acquaintance with our predecessors' researches was not of any great assistance to us. Moreover, the spherical form aimed at greatly complicated the problem, and I must admit that all our calculations would have remained fruitless if M. Psaroudaki had not been an extremely clever mechanician, and capable of directing the manufacture of tools and moulds better than any maker at the disposal of the French Company now working the invention. The system at which we at last arrived, and which gives us every satisfaction, was patented in France and elsewhere,* in 1893 and 1894, under the name of *Holophane globes*, *i.e.*, globes that are *luminous over their entire surface*, which is their chief characteristic. Fig. 1,

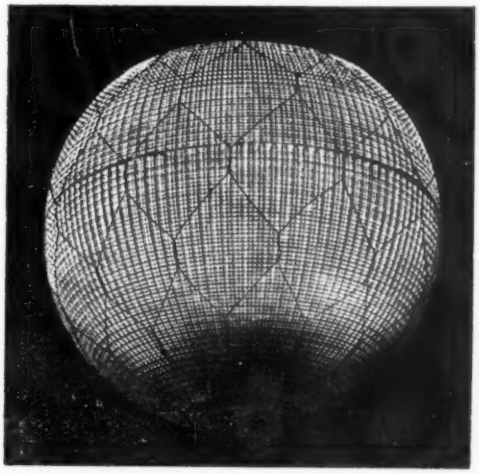
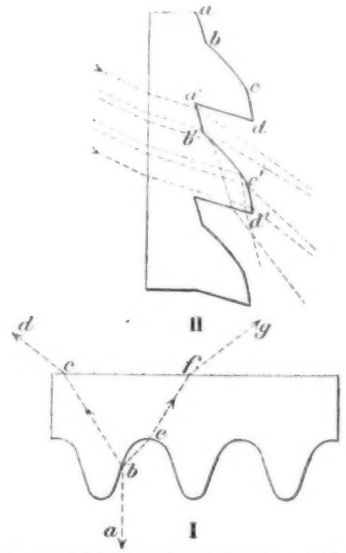


Fig. 1.—General Aspect of a Holophane Globe when Lighted by the Electric Arc.

which represents a photograph of the globe containing an arc lamp, shows well the effect obtained. The arrangement was only taken up for industrial purposes a few months ago, by Messrs. Engelfred & Co.

Our invention is distinguished from Mr. Trotter's not only by its general outline, but by the form of the flutings.

1. The outer flutings (fig. 2), instead of being refractory only,



I.—Trotter flutings. II.—One of the external flutings.

Fig. 2.—Profiles of the Holophane Globes and Shades.

as in Mr. Trotter's system (figs. 3, 4, 5), are both refractory and reflecting, the reflecting part predominating. The advantage

* Sitting of March 17th, 1893, p. 84 of the *Bulletin* de la Société de Physique.

† French Physical Society, sitting of July 7th, 1893.

* England, Belgium, Germany, Austria, Hungary, &c.

of this is that they send out the light at a greater angle of diffusion than the flutings that are refractory only, and consequently render the globe bright all over (fig. 1); moreover, there is no fear of the light being clouded by dust, as this in no way affects the total reflection; and they do away with the loss of light entailed by the employment of horizontal flutings, which are only reflective. The outline reproduced by Mr. Trotter in fig. 8 of his article is not used now in our globes.

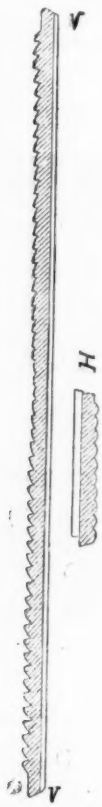


Fig. 3.—Profiles of Panes of Mr. Trotter's Lantern.

2. The inside flutings are concave in form (fig. 2), this arrangement avoiding the loss of light by reflection at the entering of the rays in the glass, contrary to Mr. Trotter's convex flutings (fig. 5).

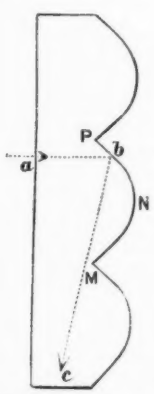


Fig. 4.—External Flutings of Mr. Trotter's Cylindro-Spherical Shades.

3. At the upper part of the globe (fig. 6) we arrange prismatic flutings which produce the total reflection towards the centre of the globe, so that the globe itself serves as a mirror, as if it were silvered.

According to circumstances, we must produce not only the diffusion, but the most advantageous distribution of the light. Here, again, is a difference between our system and Mr. Trotter's; we no longer try to realise absolute uniformity of lighting on the ground, for we, like him, have seen from

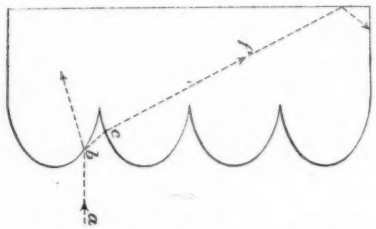


Fig. 5.—Kind of External Flutings of Mr. Trotter's Cylindro-Spherical Shades.

our experiments in 1893, that the effect thus obtained was bad for street lighting. But we have only two kinds of globes:—

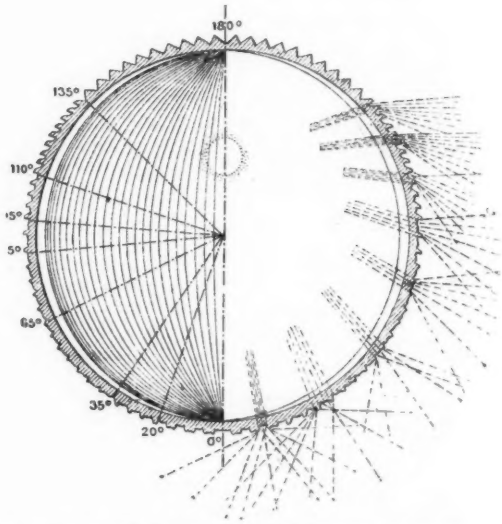


Fig. 6.—Complete Profile of a Holophane Globe of the Second Class.

From the Electrical Review, December 14th, 1894, p. 709.

1. Those which simply diffuse the light in all directions, for rooms.

2. Those which send the light down upon the ground.

These are best suited to outdoor lighting. We have calculated them so that the maximum of the curve of distribution occurs not at an angle of 45° to 50° from the vertical, as is the case with the natural rays of the continuous current arc, but at a much greater inclination, as shown in the curve of distribution in fig. 7, from the Central Electrical Laboratory, Paris.

The effect obtained by the globes of the second class may be seen on the Boulevards Bonne Nouvelle and St. Denis, Paris, where they are used with excellent results. At the Antwerp Exhibition they were used for lighting the *Grand Bassin*, and obtained a gold medal.

Our calculations have been made with the help of numerical tables drawn up at the commencement; the methods of forming the outlines of the flutings, which differ considerably from Mr. Trotter's methods, are explained in detail in the French and Belgian patents. I have not yet had time to write an article on this subject, although it has long been my intention to do so.

Since the foundation of the "Société d'Eclairage Holophane" in France, our system has undergone several modifications, and in particular has been extended (as was provided for in our patent) to other shapes than globes, and to other sources of lighting than the arc, for instance, the incandescence lamp, and the Auer burner. Experience has in fact shown that for the greater number of modes of lighting in use at the present day, there are only two desiderata

to be provided: to diffuse the light to the best possible advantage, without having recourse to opal or ground glass, and to throw down on the ground a considerable

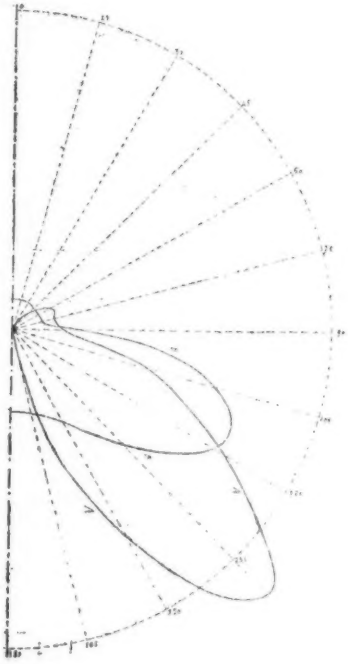


Fig. 7.—Curve of Distribution of the Luminous Intensities of a Holophane Globe of the Second Class, compared with the Curve of the Naked Arc.

proportion of the light which would naturally be cast on the ceiling, without trying for uniformity in the lighting of the ground. With large sources of light, our

Fig. 8.—Egg-shaped Holophane Shade for Electric Incandescence Lamps.

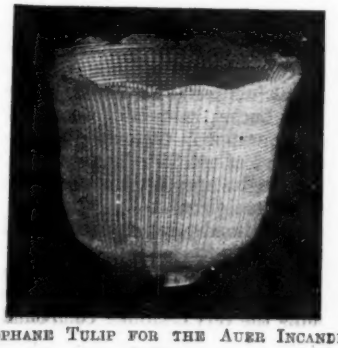


Fig. 9.—Holophane Tulip for the Auer Incandescent Gas Light.

mixed flutings satisfy these two conditions very well, the outlines being very simple, and for the most part formed of straight lines. Figs. 8, 9 and 10 represent an egg-shaped shade for enclosing the bulbs of incandescence lamps, a holophane tulip for the Auer burner, and a cone for the same purpose. These forms gained the greatest favour as soon as they appeared, and the Paris Gas Company, having experimented with the tulip and the cone, and found them to entail a loss of only 13 per cent., recommends them to all consumers; they are of the greatest service where the Auer burner is used in rooms.

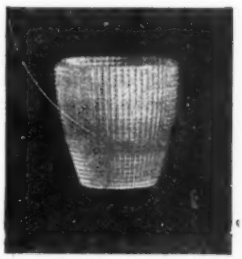


Fig. 10.—Holophane Cone for either Gas or Electric Incandescence Lamps.

In conclusion, it can be seen that our system has nothing in common with M. Raffard's somewhat primitive system, and Mr. Trotter's more perfect one, beyond the starting point, *i.e.*, the employment of double flutings, and that the special processes used make it really a new invention. Nevertheless, I willingly hail Mr. Trotter as our precursor, and as an inventor far in advance of his times, and take this opportunity of thanking him for his good advice, which was given in such an attractive and courteous form. In the working out of our system, we believe we have avoided the causes of failure that he pointed out to us, and we have every reason to hope that Messrs. Engelfred & Co., who have met with a most favourable reception from the public, and who have some difficulty now in satisfying the numerous demands of their customers, will not have cause to regret having undertaken the wholesale exploitation of this invention.

SOME POINTS ON THE WORKING OF CENTRAL STATIONS.

By J. HARDIE McLEAN, M.I.E.E.

The commencement of a new year would appear to be a most convenient time for the consideration of what may be done to cheapen the cost of production of a unit of electricity, and thereby lessen the charges to the consumer. In the year which has just gone, central station engineers have been making strenuous efforts to bring about the cheapening of their production, which is undoubtedly handicapped in the matter of cost, when a comparison is made with other methods of illumination. It would be interesting to review the chief reasons why the electric current is comparatively dear, and to discuss the means by which in future a better result may be arrived at.

A consideration of the returns of the capital expended in electrical works undertakings and the revenue returns upon the same, does not leave room for doubt that those responsible for the first outlay on plant and machinery have in many cases neglected to give proper weight to the principle that the supply should increase in proportion to the demand, that is to say, to expend on capital works a sum upon which there is no reasonable anticipation of a remunerative return for four or five years or even more is one great bar to the reduction of the price to the consumer. The lessons that have been taught by this method of procedure are undoubtedly having their effect on the more recent plants that have been laid down, and the satisfactory results obtained in a few cases point to the fact that former experience of over capitalisation has been laid to heart. The only prospect that appears to be open to the older undertakings to bring them into line with those that have benefited by experience, and the cheapening of the electrical plant generally, due to the severe competition now existing, would seem to

be a reduction of capital. The monopolies, until recently existing in almost every manufacturing concern, which are rapidly becoming eliminated, due to the expiration of patent rights and royalties, have had their effect on the first cost, consequently newer companies have been able to secure a remunerative return on the more moderate first outlay; further progress in this respect may reasonably be anticipated in the future. In short, plants more in proportion to the immediate demand, and the facility for early extensions at a moderate cost when the demand warrants it, are taking the place of the very large plants which were formerly put down. The establishment of such plants, taken into conjunction with the cheapening of the reduction of the first cost on account of the reasons above stated, will form two most important factors in the prospective reduction of the price of the Board of Trade unit.

Electricity supply works, as has been shown, should commence on a comparatively small scale supplying the best districts, to enable the undertaking to be placed on a paying basis from the first; but the claims of outlying districts must be kept in view, and it is to be feared that the flexibility of some of the systems at work will be severely taxed when the demand from the suburban districts can no longer be withstood. This clearly points to the almost universal adoption of a high-tension current, either continuous or alternating in the great majority of towns, otherwise the losses in the conveyancing of the current to the distant consumers will have its effect on the selling price of the unit; and here it might not be out of place to discuss the materials which town councils and other bodies have at their disposal, in the form of published statistics, to guide them in the selection of a system. It is not an uncommon practice for town representatives to put their finger on such and such a station, and to compare it with another in which the conditions are widely different, and to say that it costs half as much to produce a unit of electricity in one as another, thereby attempting to show the merits or demerits of any particular system. To select examples of the many ways in which these published returns prove a stumbling block to the uninitiated: no regard is paid to the number of units sold in comparing the financial results of undertakings in different towns. Young installations with only a small proportion of their capable lamps connected, and with a consequent small number of units sold, are placed in juxtaposition with older and more fully loaded up stations whose output is almost as great as can be supplied, without additional plant (and who are, therefore, producing their electricity as cheap as it is almost possible for them to do), without any explanation to make it clear that the younger companies may, when their turn comes to be well loaded, produce and distribute their current with much better financial success. The same argument applies to nearly every one of the columns in the table of costs with which we have become so familiar.

Again, there is no notice taken whatever of that all-governing item, the load factor, which varies to an enormous extent in different towns, the raising of which, without increasing to any great extent, the curve at full load should be the aim of all concerned.

The capital expended in many of these undertakings by reason of the facts before recited, leads to misconception of the dividend-earning capabilities of many of the systems controlling the commercial operations of the companies whose working results are summarised.

Having now dealt in a general manner with the question of first cost and the importance of a proper system as affecting the price of the unit, the next question which presents itself for consideration is the most economical method of working a station, both from an engineering and commercial point of view.

The efficient adminstration and system of records by which a constant control may be exercised over the various departments of expenditure in goods or wages is undoubtedly a great cause of economy in central stating working.

It is imprudent to allow the results of the working of a station to remain in doubt for any lengthened period, but a system should be available to check in every detail the expenditure in each department week by week.

It is doubtful whether the systems of account keeping have come up to the recognised standard now generally prevailing in ordinary manufacturing concerns, and a large percentage of loss has been sustained by the neglect of a proper system of accounting for the disposal of the stores necessary for the working of the station. By an efficient system of prime cost recording the exact expenditure day by day, the engineer is in a position to at once trace to its source and correct any extravagance in the use of stores and labour, and the adoption of a good system of central station book-keeping will be the means of creating in the future considerable economy.

The ideal circumstances under which a central station could be economically worked are too well known to require recapitulation, and what is really wanted is a means of raising the day curve without a corresponding raising of the curve at full load. Will the means at the present time advocated accomplish this? The day load is only an advantage when the needs of consumers accommodate themselves to the power available at all times. For instance, let it be supposed that there is a sufficient load in the day to employ the whole plant. In the evening it would be necessary to largely increase the plant to cope with the combined load for lighting, motive power, &c. It is not practical to suppose that cooking, heating, and power for manufacturing purposes will always and only be used in the daytime; in fact, so far as heating, cooking, and motive power for domestic purposes are concerned, the demand in the evening is not likely to be so greatly reduced as may be supposed, and what is to be guarded against is the period in the evening when the two loads would overlap.

One important means suggests itself in which the day and early morning current might be utilised without unduly increasing the demand in the evening when the plant is supplying electricity for lighting purposes, namely, the charging of accumulators for electric traction. With a sufficient reserve of accumulator sets there is no reason why a service of traction could not be maintained during the hours in the evening when the engines would be otherwise engaged than charging the cells. The current could be supplied profitably at a cheap rate, and if the tramway service was owned by the corporation or company supplying the current they would then obtain their current for traction at cost price and secure the profits derived by the tram service, in addition to employing the machinery and men constantly.

An endeavour has been made to show in a few instances in what manner a reduction in the price of a unit to the consumer is to be looked for with our present systems, namely, by a more moderate capital expenditure, by employing a system whose flexibility will allow of supplying electricity to the whole district, by economical administration and an efficient system of accounts, and by increasing the day load without unduly raising the curve at full load.

FROM THE ELECTRIC FURNACE.

A remarkable product of the electric furnace has aroused a considerable amount of interest in gas manufacturing circles, as it promises not only to furnish the best of all gases for enriching common gas, but also a gas which is itself the best illuminating gas known to chemists, namely, acetylene.

A Mr. T. L. Willson, an American, experimenting in an electric furnace with a view to reduce lime to its metallic element, calcium, used a powdered mixture of chalk and charcoal under the heat of the electric furnace, which fused into a heavy metallic-like mass. Upon examination of the mass after cooling, no calcium metal was found. By chance a lump was thrown into a bucket containing some water; a rapid evolution of gas immediately occurred; the powerful odour of this gas compelled attention to its presence; it was found to burn when a light was applied to it; further tests proved it to be pure acetylene.

And later on the fused mass was found to be carbide of calcium containing 40 parts of calcium and 24 of carbon. In the electric furnace the calcium had actually been reduced, but in the presence of the excess of carbon it had combined therewith, forming the very desirable compound from which acetylene is so readily obtained. Thus, as is usual in discovery, this substance was produced in attempting to form a different substance altogether.

Carbide of calcium was not an unknown compound. Wohler produced it by fusing an alloy of zinc and calcium with carbon powder, and used it for producing acetylene.

And quite recently Travers made carbide of calcium from a mixture of chloride of lime, carbon, and sodium.

Carbides of barium and potassium, and other elements, also produce acetylene.

But all the chemical methods of producing carbides of lime, or other elements, are too expensive for practical purposes, hence the production of acetylene has never been attempted for commercial supply, although its enormous illuminating power has long been well known.

The importance of Willson's process arises from the use of common raw materials, chalk and carbon, in any form, and electrical energy, to produce the carbide in any quantity.

The electrical energy is the expensive item in this process. Just at present it is difficult to arrive at a proper estimate of the cost, but the following figures are those quoted for its production at the American works in North Carolina. 2,000 lbs. of carbide can be produced from a mixture of 1,200 lbs. of fine coal dust and 2,000 lbs. of burnt lime with an expenditure of 180 E.H.P. per hour for 12 hours. On this basis the cost comes out at 15 dollars per 2,000 lbs. of carbide as the cost price, and it is quoted wholesale at £4 a ton by some later writers on the subject.

It has been proposed to take current from the idle machinery of our central stations during the daytime to work furnaces producing the carbide; but whether this can be done remains to be seen. It seems very doubtful whether electrical energy produced by steam power can be used for electrical furnaces. The American works estimate their water power for 180 E.H.P. costs only 50 cents per hour.

Now, 180 electrical H.P. equals nearly 135 units of electric supply, and as the lowest prime cost of a unit runs about 2d., the power from a central station would cost £1 2s. 6d., against the American 50 cents for the same power.

It would appear, therefore, that the commercial success of the calcium carbide industry depends entirely upon cheap water power, and cheap water power is nearly as scarce in this country as cheap steam power.

Of all the heat produced by the coal in a boiler furnace working a steam electric plant, only about 5 per cent. of it is recoverable in the electric furnace, hence the impossibility of economically working electric furnaces with steam power.

We may at present take the price at £4 per ton, 2,000 lbs. of carbide produce, 10,500 cubic feet of acetylene, or as a more easily remembered figure, 1 lb. of carbide produces 5 cubic feet of gas, merely by mixing it with cold water. It is made up in rods, 1¼ inch in diameter, weighing 1 lb.

A rod put into an iron bottle with a little water added, and then closed tight, becomes at once a portable supply of 5 cubic feet of gas, and as a consumption of half a cubic foot per hour gives 20 candle-power, the enormous light-giving capacity may be imagined, a light of 20 candles being maintained for 10 hours from a pound of carbide in a cylinder 4 inches diameter and 16 inches long.

The acetylene is produced by the carbide and water decomposing each other, exchanging partners as it were; the oxygen in the water seizes the calcium, releasing the hydrogen and carbon, these immediately unite, forming the acetylene.

Acetylene burns in small flat flame burners; its illuminating value calculated on 5 cubic feet per hour consumed is no less than 240 C.P.

In our leader of some weeks ago, we had occasion in discussing Welsbach lights to refer to the difference between luminosity and diffusive power, and referred to the fact that a high temperature light might appear powerful and yet have very little diffusive power.

Experiments by Professor Vivian Lewes, and others, on acetylene lights, confirm these views very fully. The flame of acetylene although giving a brilliant white light of 240 C.P. per 5 cubic feet, is really much cooler than a gas flame giving only 16 C.P. Professor Lewes found by testing with a Le Chatelier thermo couple that the highest temperature in any part of an acetylene flame was a trifle under 1,000° Cent., while in an ordinary burner, with common gas, the temperature was 1,360° Cent. These figures are very significant, and give us a glimpse through the obscurity surrounding the production of light and its measurement. One experimenter with acetylene expresses himself on these points thus:—"I was able to hold my hand over the flame at a distance of 8 inches; the flame seemed as though it had *quantity* rather than *intensity* of light." The italics are ours; these words indicate properties in lights which have not yet been thoroughly investigated, and which no photometric methods have yet taken into account.

The old time electricians used the same terms, *quantity* and *intensity*, before the reduction of the measurement of electrical quantities to an exact science; similarly in the matter of light we seem to require a reduction of the photometric measurements to an exact science.

If the calcium carbide can be produced in countries where water power costs little or nothing, it, no doubt, will become an important factor in the calculations of the electrical engineer.

By its means common gas can be so enriched as to give an enormously increased C.P., and if used as a lighting agent alone it gives the most light for the money expended, even at £4 a ton for the carbide.

Then for portable lights it totally eclipses a lead accumulator of electrical energy. On the other hand, as an American contemporary puts it, "It is the same old gas." It has none of the sanitary advantages of the incandescent electric lamp, it consumes the oxygen in the air, and gives off smoke and carbonic acid.

Of the Welsbach light we have no fear whatever, its high heat, poor diffusive power, and bad quality of light, will soon end its career; but in acetylene there is a genuine improvement in gas as an illuminant, and, no doubt, in some cases, it will prove a formidable competitor, especially against arc lamps, and generally in out-door lighting where gas products are not objectionable. But we do not believe there is any immediate cause for apprehension, as we rather think the cost is much underestimated for the purpose of booming the American manufacturers.

Apart, however, from its illuminating properties, acetylene has a much more important aspect commercially, for from it a great many hydro-carbon compounds can be made, such as benzine, hydro-cyanic acid, ethylene, alcohol, and many other bodies follow from these.

Acetylene liquefies at 1° Cent. under a pressure of 725 lbs. per square inch.

Carbide of calcium is of interest also as a vehicle for the storage and transport of energy from distant waterfalls. The carbide itself may be transported or the acetylene liquefied in tubes, in which case the same lime can be used over and over again. Norway and Sweden with their plenty of water-power and wood charcoal, might, with the aid of the engineer and electrician, make an industry of this chemical.

Prof. Lewes in reply to an enquiry on the point said that a horse-power of electrical energy consumed in incandescent lamps gave light equal to 28 compared with 44 given by a horse-power consumed in producing acetylene light, that is, in making the carbide.

This difference would not, however, be sufficient to enable steam generated carbide and acetylene light to compete with electric incandescent light, it would not cover the extra labour and the other drawbacks to gas light. Although, for the same power expended in the light production, acetylene gives 44 against electric 28, that fact does not make it at all likely that it would be profitable to make carbide of calcium at electric supply power houses; the handling of the materials and the delivery of the carbide, its packing and storage and the finding of a market for it would never be met by this difference in power consumed. Besides, we don't make out the difference to be quite so much as the professor's figures, for with incandescent lamps at 4 watts per C.P., it comes out as 40 is to 50 very nearly. With electric lamps working at 3·25 watts per C.P., power for power, the two lights are equal.

With arc lamps the tables are turned completely, for an ordinary arc of 10 ampères at 45 volts with a globe and a resistance will give one candle for two watts, thus making the light given for the same power equal to 80 for the electric arc, and 50 for the acetylene light.

But the question is not altogether one of power, although it is of interest in settling whether carbide can be made at a profit with present power-house plants.

If water-power can be got at the American estimate = 50 cents per hour for 180 horse-power, then the cost of acetylene comes out as low as its advocates claim, namely, 6s. 4½d. per 1,000 cubic feet. Although double

the average price of common gas it gives 15 times the light, or 7·5 times the light for the same money.

Now, to compare its cost, light for light, with incandescent electric light, 6s. 4½d. will buy 13 units of electricity, which, at 4 watts per C.P., gives 3,250 C.P., while 1,000 cubic feet of acetylene gives for the same money 28,000 candle-power for one hour.

Whether acetylene light will become a formidable rival to the electric light seems to depend very much on the cost of water-power, and we would be pleased to hear from some one who knows by experience just what it costs to run a water-power plant per E.H.P. delivered.

SMALL DYNAMOS: THEIR CONSTRUCTION.

III.

The field magnet shown in fig. 1 is to be of the Manchester type, the pole pieces, top and bottom, are similar in shape and size, and the cores are of good soft iron, as shown, $2\frac{3}{4}$-inch diameter. They are turned down at each end to $2\frac{5}{8}$-inch, where they enter the pole pieces.

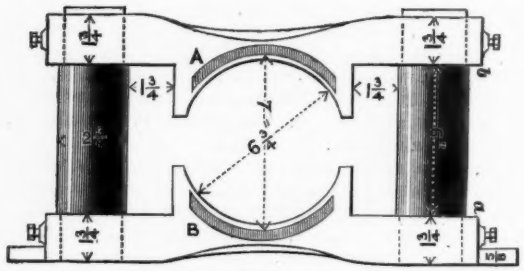


Fig. 1.

It is a mistake to leave a large shoulder here, and have a small hole, for that introduces a lot of magnetic resistance.

A steel founder might cast the cores into the bottom pole piece, and make the top one fit on to the upper ends, and thus supply the magnet complete, or the cores may be tapered from A to B, and cast with the bottom pole piece of good soft steel; in that case the cores would taper from 3 inches at the bottom to $2\frac{3}{4}$ inches at the top.

On the pole faces at the sides are projecting tubular sections to carry the bearings for the shaft; these are seen in fig. 1, at A and B, and at A, A, in fig. 2, the plan, and at A, A,

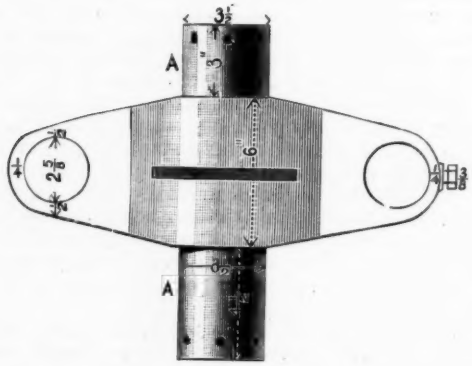


Fig. 2.

B, B, the end elevation, fig. 3. When the armature tunnel is bored out, preferably by a boring bar and cutter, these projecting supports are also bored out at their outer ends, and for a distance of 1½ inches inwards, and must at the same time be faced truly.

This being done, a true concentric bearing is secured, and the parts reduced to a minimum. The bearings are of brass, and are merely thick tubes carried in hard wood discs fitted into these bored out ends of the armature supports. Fig. 5 shows the discs of hard wood. Birch, beech, or teak wood will do very well. The tubular projecting sections need not be more than $\frac{5}{8}$ths thick, and may be only ½ inch. The hard wood discs are to be held in place by screws well fitted through the holes shown, and a hole to take a brass pipe

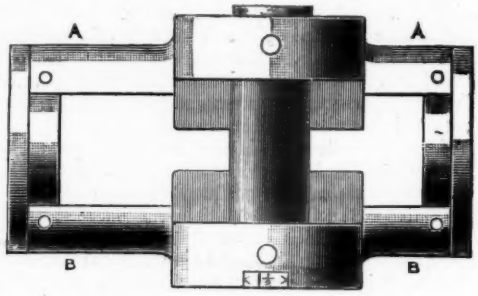


Fig. 3.

of $\frac{3}{8}$ths inch diameter outside down into the central hole, for the bearing, is bored through the one side radially into the discs as shown dotted at C, fig. 5. The brass bushes or bearings will be described later on with other small details.

The bore of the armature tunnel is to be $6\frac{3}{4}$ inches full, and the bore of the projections for bearings 7 inches; all other sizes are figured, except the thin central part of the pole pieces, which need not exceed $\frac{3}{4}$ inch.

Four ½ inch screws fix the magnets together.

The magnets may have lugs cast as shown on the lower half for screwing down the machine.

Shaft is of steel $\frac{7}{8}$ths inch diameter, and is shown in fig. 5 as 18½ inches long, but that is the minimum length; it may be made 20 inches long.

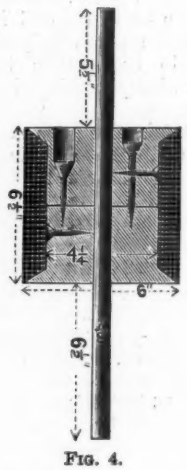


Fig. 4.

The shaft may be readily made from steel of 1 inch diameter, or if carefully straightened, may be made of $\frac{7}{8}$ths inch stuff, and turned up at both ends for the bearings.

The armature bobbin is shown in section in fig. 4. It is made of two pieces of sound hard wood, screwed together by four 2-inch screws well sunk in. The wood pieces should be $6\frac{1}{4}$ inches diameter and 3 inches thick to begin with. A hole is first made in the centre, so that the shaft may fit in firmly, the woods being forced on, using a little oil, fixing them in position as follows:—First carefully put in the four screws binding the two pieces together, then, at right angles to the axis, bore three holes to take firmly 2-inch screws, as shown in section. Before inserting these screws a drill should be used to make shallow holes in the shaft, into which the points of the screws enter, thus keying the bobbin thereon.

In these operations the greatest care must be taken to use drills of the proper size for the screws, so that they fit firmly, yet not requiring forcing in. A drop of oil should be let into the holes before fixing in the screws.

The countersink for the radial screws must be deep, so that the point enters the shaft before the head binds.

The bobbin on the shaft should now be turned up to the shape of a bobbin of cotton thread, and to the dimensions. As shown in fig. 4, the angle of the tapering sides should be 60° with the horizontal body; the edge of the side at the top should be one quarter inch thick. These edges are to be slotted out to take projecting slips of hard fibre or wood to form divisions into which the winding of wires is laid; fig. 6 shows the use of these slips. The slots should be $\frac{3}{16}$ths inch deep, and a little less than $\frac{1}{16}$th inch wide, and the slips can be glued in after the iron wire is wound into the bobbin; but the slots must be cut before this wire is wound.

The edges must have 40 divisions; that is, be divided into

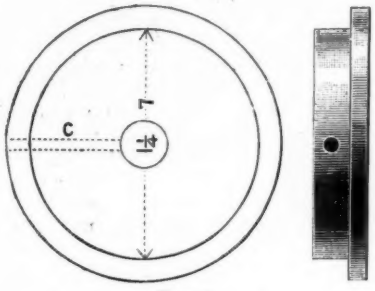


Fig. 5.

40 spaces with a slip between each so as to carry 20 coils of wire, each coil having 10 turns thus giving us 400 turns, counting wires all round the armature.

After the edges are slotted the bobbin is to be filled up

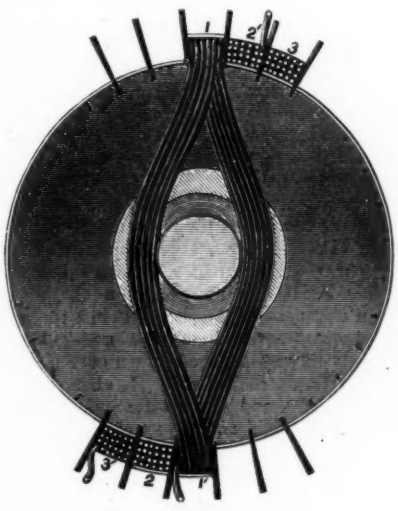


Fig. 6.

flush with No. 18 soft annealed black iron wire. The winding must be carefully done by turning the bobbin in a lathe at slow speed, or by a hand winch on the shaft, keeping a strain on the wire, and never allowing the bobbin to turn back and slack the wire. The wires must lie as close and firmly together as possible, and if properly wound, will be as smooth and true as need be.

REVIEWS.

Forty-three Graphic Tables or Diagrams for the Conversion of Measurements in Different Units. By Robert H. Smith. London: Charles Griffin Company.

It falls to the lot of many of us to require to make conversions, especially between English and metrical units. We remember once testing a pair of engines in France, where for barometer we had a column of mercury graduated in French feet. It was evidently of premetrical age. Steam gauges were marked in kilos. per centimetre^2, and we had our own English indicator, and so on. In working out the results, such a set of diagrams as these before us would have been most useful. They are drawn on paper ruled to squares of $\frac{1}{10} \times \frac{1}{10}$ inch, and are, of course, all straight line "curves."

Such diagrams are very easy to construct. The "curves" all start from the zero point for both units, except, of course, in the thermometric diagrams, which require to start 32 to the right of zero on the Fahrenheit abscissæ, while in most of the diagrams when the curve has extended right across the scale, it is extended by a parallel curve starting vertically below the ending of the upper curve, the height of the corresponding ordinate being carried forward again from the zero line, and marked on the right in place of the left side of the page. Given accurately engraved squares, such diagrams are most easy to make or extend, and anyone finding himself in need of a further diagram need only calculate and lay off carefully the point of intersection of the conversion curve with the limiting edge of the page to have at once all values of the conversion. This can easily be done in red ink on some of the present pages, but we think it would have added to the value of the book to have inserted a few pages specially for engineers to lay out their own diagrams, for every engineer of varied experience requires to make many conversions that he would never expect to find in a set of tables like the present, the chief defect of which is this omission of a few spare pages to supplement what we may term the conventional conversions that are alone practicable to be printed in a reasonable bulk of volume. These diagrams will be found fairly extended. In the thermometric page the conversion is from absolute zero to 5,000 F. This page contains nine diagonal lines, but by the simple means of printing along each diagonal the value of its two extremities, confusion in using the tables is avoided.

The author claims that the conversions can be effected by inspection within from one-tenth of 1 per cent., to 1 per cent. of the whole quantity converted, the average being about ·2 per cent. To illustrate the miscellaneous nature of the diagrams, it may suffice to name here a half dozen:—Acres and hectares; Gunter's chain and 20-metre chain; pounds per square foot and inches of water-head; English and French horse-power; specific gravity and pounds per cubic foot; foot pounds and Joules.

Prefacing the diagrams are explanatory notes of each, and, for approximate mental conversions, there are given the useful numbers well to remember. Altogether these are a very useful and good set of diagrams, and ought to be in every office where even occasional conversions are required, for even where absolute accuracy of conversion is required, they will form very excellent checks on results. Simple conversions of feet and metres are readily seen to be in the ratio of 1 to 3 +, but in many other conversions less familiar, the critical faculty may need assistance. For close reading of results, we think users of the diagrams would find it useful to employ a short scale of 1 inch divided into, say, $\frac{1}{100}$th, by which the actual height at which the conversion line crosses any line in the diagram can be closely read off on the principle of the diagonal scale somewhat. The author has coined a new word, "parallelly," in his prefatorial remarks, which, however, is no detraction from the value of the tables. We would add that when a conversion is made, it is best to read off the amount at the higher end of a curve to secure better accuracy. Thus, in converting square metres to square feet, the diagram appears to read 10·75 square feet = 1 square metre at the lower end of the diagram. Transferring to the upper end, 10 square metres reads 107·5, or 1 = 10·75, which confirms the apparent first reading. Again, 10 cubic inches = ·16 litre, but 100 cubic inches reads 1·62 litre, while 1,000 cubic inches = 16·375 litres. The true figures are given in Nystrom's table as 16·387, while the same authority gives 10·764 as the value of the square metre in feet. From these two examples it would appear that the tendency of the eye, even with a magnifying glass, is to read lower figures on the conversion than actually should be shown. This is when reading vertically. In reading along the lines horizontally, the reverse appears to be the case. With a little practice we should think fairly accurate results could be attained, more particularly, however, if the conversion lines were drawn finer.

The Indicator and its Practical Working. By A. G. Brown. Published by the Globe Engineering Company, Manchester, and 7, Billiter Buildings, E.C.

This is a publication evidently got up by someone who knows the requirements of the steam engineer, for he has supplemented a very practical description of the use of the steam engine indicator by very numerous tables of the various coefficients so essential in the elucidation of steam indicator diagrams, and the questions closely allied thereto. Over 60 different tables are given of everything needful in the art, including one of volume and weight of air at temperatures from 0° to 3,300°, one of specific heats of the commoner gases at constant volume and constant pressure, a fairly extensive table of the three usual thermometer ratios, and a conversion table from pounds per square inch to kilos per square centimetre, together with other metrical reduction tables for lines and square measure and weights.

The steam tables are good, but though we find one giving the saving due to a hot feed, we do not find that most useful table of factors of evaporation for reducing evaporation rates to the rate from and at 212°.

We observe, too, that the value of J is set down as 778 in place of the customary 772, to which we have been accustomed since Joule fixed this number as the mechanical equivalent of heat. The newer number, usually attributed to Griffiths or Rowland, is causing some little confusion, and we have seen no authoritative statement as to the preferment of either of the two numbers. If there is a likelihood of 778 being really the more accurate of the two values, it might be as well to have the value of J changed, and we think the subject might at least receive some attention at the hands of the Institution of Mechanical Engineers, for example, who might say, with authority, which of the two figures should be continued as the standard for steam engine calculations.

In addition to the numerous tables there are illustrations of different types of diagrams, faulty and otherwise, to demonstrate points connected with indicator use, and also diagrams showing various reducing gears, methods of fixing, and a description of the action and use of a diagram averaging instrument — an integrator — for working up diagrams. Steam engineers will find this a very useful book to have by them, collecting as it does so much special information between two covers. It is well printed on neutral toned paper, and neatly bound, and reflects great credit on its author.

Electric Lamps and Electric Lights. By J. A. Fleming, M.A., D.Sc., F.R.S., &c. London: *Electrician* Printing and Publishing Company, Limited.

This book is a transcript, with additions, of a course of four lectures on "Electric Illumination," delivered by the author to afternoon audiences at the Royal Institution. The preface states that the original aim was to offer to a general audience such non-technical explanations of the physical effects and problems concerned in the modern applications of electricity for illuminating purposes as might serve to further an intelligent interest in the subject, and perhaps pave the way for a more serious study of it. We have perused the pages with a considerable amount of interest, and we hope with profit. For example, we had hitherto been humble believers in the doctrine laid down some time since by a gentleman bearing the slightly Jewish Christian name of Isaac, that force is that which moves, or tends to move, matter. Now we learn, on page 179 of the book in question, that electromotive force is a "force setting electricity in motion." The obvious inference is that electricity is matter, that it possesses weight, and that therefore we may hope shortly to hear that the Board of Trade has surmounted the meter difficulty by decreeing that electricity shall be sold by the hundredweight. We had hoped to have made equally great strides in our knowledge concerning the manufacture, life, and efficiency of incandescent lamps of English make, but here we were sadly disappointed, for although the author, in virtue of his connection with the Edison-Swan Company, must be well acquainted with a number of valuable and interesting facts on these subjects, he does not disclose them, but quotes almost exclusively from American sources. Bearing in mind his previous efforts, we were not so surprised as we might otherwise have been to find that he has also gone abroad for his language. Such words as "wastage" and "whizzy" might, perhaps, be pardonable from ordinary mortals, but a learned University professor should certainly be able to express himself clearly by one or other of the many thousands of words in the English language. It took us some time to understand what was actually happening when we were told that "Under some circumstances an electric arc burning quietly sets to work suddenly to hiss loudly," but perseverance as usual conquered. In spite, however, of the loose and irritating style frequently adopted, and in spite, also, of the fact that many of the figures contain a number of letters to which no reference whatever is made, the book is decidedly above the average, and will well repay perusal. A somewhat lengthy description of the so-called "Edison effect" is given, and the principles underlying the action and construction of transformers are elucidated carefully and with precision. Much of the matter, which must have proved difficult of comprehension by an ordinary Royal Institution audience, will, without doubt, be instructive as well as interesting to readers who possess something more than a superficial knowledge of the subject. Many interesting points are brought forward in connection with photometry, a subject which is now receiving that amount of attention which it deserves, and the same may be said of the author's remarks on illumination. The book is unusually well printed, with good type and on good paper, and is provided with a good index.

Electricians and their Marvels. By Walter Jerrold. London: S. W. Partridge & Co.

This is another addition to the already large number of books in which is related after a fashion the history of electric lighting and telegraphy, along with some of the chief events in the lives of pioneers. There are plenty of similar books in which most that this one contains has been told over and over again, in fact, it appears to us to consist chiefly of a compilation from the writings of other men, as the numerous quotations, anecdotes, &c, testify. There are briefly summed up the lives and works of such men as Wheatstone, Cooke, Morse, Tesla, Edison, &c. All that is said regarding Wheatstone is fully justified, for Sir Charles's endeavours in electrical science well merited the author's laudatory remarks. The great difficulties encountered in laying the first Atlantic cable occupy a number of pages. Electrical men will not find much to interest them in "Electricians and their Marvels," and the non-technical reader will not be likely to wish for more when once he has digested the contents of Mr. Jerrold's book. It abounds in errors in the spelling of names, and also erratic statements which the non-technical reader could not be expected to detect.

Latent Heat of Steam and Absolute Zero. By William Donaldson, M.A., Cambridge.

This is a little pamphlet of 14 pages which we have read through several times, and are still unable to discover just what it is Mr. Donaldson intends to convey. It appears to us exceedingly involved in style, and entirely without lucidity. In the introduction we are informed that the value of $J = 772$ has been used in computations involving the use of temperatures, as shown by a thermometer of equal graduations; that the adoption of a constant value for J assumes that equal increments of volume correspond with equal increments of heat.

But by calculations made by the author from the data of the steam tables, the coefficient of expansion per increment of unit of heat is constant, and the heat necessary to raise the temperature of 1 lb. of steam at constant volume on the constant coefficient scale (of the thermometer) is about 1,132 foot-pounds, which may be compared with the 235 of the ordinary accepted tables. But we are told Joule's experiments are unreliable, and we suppose we must equally condemn those of Rowland's, which confirmed Joule's.

Regnault's experiments, we are told, show that steam has a specific heat at constant volume of from ·3 to ·45, the drier steam having the greater heat; and these data must be

thoroughly unreliable, for if the specific heat of steam be less than that of water, how can wet steam have a less specific heat than dry steam, even if the increment of pressure due to the rise of temperature at constant volume is sufficient to prevent the conversion of the moisture to steam? We are then asked to rely on Joule to show that the specific heat of water is not greater than that of steam, and upon Regnault to show it is not less. This pins us to admit that the specific heat must be equal, and "steam engine efficiencies afford irrefragable proof that they are equal." This appears to be the only plain statement in the pamphlet. We may take it that steam has, according to our author, a specific heat equal to unity. Then comes the definition of latent heat of steam as the difference between its total heating power and its thermometric or sensible heat. This is the old definition, and, so far, is good and understandable. But now follows a statement we cannot grasp, so we reproduce it, viz., "The latent heating power of steam cannot exceed the total heat possessed by the water at the instant of its conversion into steam, but may be less, because the total heat of the water is the sole source whence the latent heat can be derived." The idea prompting this statement appears to us to be that when turning into steam there is an enormous absorption of heat by the molecule in process of conversion, and such molecule must therefore already contain the latent heat as latent heat before it becomes steam. We do not say that the author means this, but it is all we can rub out of it. Granted that the phenomenon of ebullition is a mystery, and that the passage of heat instantaneously from fire to a vapourising molecule far away is not explicable, may we not reply to such a statement by asking, as a sort of *tu quoque*, how do the molecules of hydrogen and oxygen find their way to the two electrodes in water electrolysis? What is the molecular march between these two terminals? Our author supports his statement by saying that cylinder re-evaporation could not occur unless the latent heat of steam was contained in the water prior to evaporation. This has to us no bearing on the point. The temperature range of the cylinder metal may be left to answer this point.

Following this there are a series of propositions, all beginning with "If," which we quite fail to follow. One of them assumes that the specific heat of ice is the same as of water; another is of such value that, if accepted, it demands the instantaneous initial temperature of steam to be absolute zero. And this is the result of accepting the latent heat of steam to be equal to the total heat of water, which compels the acceptance of a theory that steam gains its temperature only after birth.

All this we cannot fathom, but it warrants the statement of the author that he has demonstrated that the number of degrees of absolute temperature of boiling water cannot be less, but may be more, than the number of units of so-called latent heat, and we have then to ascertain if the absolute temperature of boiling water can be arrived at from experimentally determined values of the latent heat when this is less than the total heat of the water.

Rankine states that a fall of pressure is accompanied by superheating (Rankine added, however, without doing work), and Rankine believed, says our author, that latent heat could only be realised by condensing the steam. How, then, can superheat be derived? It must come from the latent heat and so on, but we fear our author practically misquotes Rankine, and we again become unable to grasp his meaning until we proceed a little farther, and understand that if we take steam from a boiler, pass it through pipes immersed in the boiler, we shall evaporate more steam. Thus if $L\ J$ be the total latent heat, and v the volume of a pound of steam at pressure p, v being the volume of the water, the intrinsic self-heating power of the steam will be $L\ J - p\ (v - v)$, and by converting this by friction into heat, it will evaporate

$$\frac{L\ J - p\ (v - v)}{L\ J} = R \text{ pounds of water.}$$

Similarly these R pounds will evaporate R′ pounds, and so on, one unit of coal, originally evaporating one pound of water, will ultimately cause

$$1 + R' + R'' + R''' \text{ to infinity, or } \frac{1}{1 - R}$$

pounds of water to evaporate.

This is reasoning in a circle, if anything is. Now $p\ (v - v) = 55{,}058$ foot-pounds at 1 atmosphere, or 64,800 at 150 lbs. pressure. If J be taken at 772, we have $\frac{1}{1 - R} = 12$ for 1 atmosphere, and at 150 lbs. $\frac{1}{1 - R} = 11$, on the assumption that $J = 1{,}132$, and $L = 1{,}112$, in place of 772 and 965, we get $\frac{1}{1 - R} = 28$ and 23 for 1 atmosphere, and 150 lbs. respectively, which means that, by the author's method, we can multiply the amount of duty of coal by a figure which may be only 11, or it may be 23. This is the climax; an economy in steam raising of 2,300 per cent. on present practice. How it is arrived at we cannot see. If Mr. Donaldson is serious, why does he not put it into practice, when there are so many who would find capital if the fact were demonstrated. After a climax comes the anti-climax, and this is reached in the statement that by means of a peculiarly arranged receiver between engine and boiler, and the use of 250 lbs. pressure of steam worked down to 60 lbs. in a single cylinder engine, this engine would exceed in efficiency the compound engine, for the receiver would cause the utilisation of 109 thermal units more per pound of water than is done at present.

The final paragraph commences: "The conversion of the water admitted into the steam chest into steam before it reaches the water in the boiler," but we are again unable to grasp its drift. We take it that Mr. Donaldson has some quarrel with the present absolute temperature, and also with the subject of latent heat and thermometer graduation, that somehow the latent heat of steam is all present in the water, and gradually added to it as it becomes heated, so that the steam is endowed with the power and potency of ebullition before it is steam. What we don't understand is why it should become steam, and what further we are completely in the dark about is how Mr. Donaldson finds this out; why others have not discovered that hot water was all the while sneaking about with a skinful of heat, and so on.

But our chief grievance is with the author himself. First he says we can gain 2,300 per cent., and then invites us to a feast of a single cylinder engine only doing as much as a compound. This is nothing new. It has been claimed often enough that the compound engine was no better than the simple engine—nor is it in theory.

Finally, Mr. Donaldson is not intelligible. If a great truth be contained in this pamphlet, let us have it rewritten, so we may all understand it.

Can it be possible there is a basis of truth in the idea. We hear much of the curious economy due to using live steam to heat feed water. No one seems able to explain this, but it looks very much as though Mr. Donaldson's scheme was this same live steam feed-heating. But the actual economy gained need not be due to any such idea as Mr. Donaldson propounds.

CORRESPONDENCE.

Small Inside Reflectors for Alternating Current Arc Lamps.

In No. 895 of your paper, issued on January 18th, 1895, there appears an advertisement of the Helois Company, Limited (page 10), in which that company threaten legal proceedings against anyone using a small reflector fixed above the arc inside the globe of any alternating arc lamps.

As we are large manufacturers of alternating arc lamps with such a reflector, we consider it our duty to inform those interested that this threat is quite devoid of any reasonable grounds of substantiation.

Respecting the two patents mentioned in the advertisement above referred to, one has reference to "Improvements in reflectors for electric arc lamps," and may be passed over without notice, as it is dated July 12th, 1894, and is consequently too late for holding ground as a patent, because the reflector in question was in general use before that date, and very many had been sold.

The second patent is for "Improvements in electric lamps or electric lighting apparatus," and is dated December 14th, 1888; this, therefore, deserves a closer inspection, for mention

is made, under claim 7, of "a small reflector inside the globe." It further goes on to say: "The construction of the bridge piece, M, in the form of a disc, which is enamelled below and serves as a reflector, or the fixing of a reflector, R, to the bridge piece, M."

These words clearly show that it is not the "small reflector" in itself that is patented, but that the bridge piece, "M," is the main object to be protected, and this is either formed as a reflector, or serves to carry one. As we do not use the bridge piece, M, which serves to conduct the top carbon and a rod to the bottom carbon, and as we do not use a combination of this bridge piece with a reflector, it is quite clear that neither we, nor any other firm manufacturing arc lamps, touch this patent.

If the matter were different, and a small reflector in itself had been patented, we should long ago have been obliged to start legal proceedings to get such a patent made void, and such an action on our part would have been completely successful, as we could have proved that the fixing of a small reflector inside the globe, and above the arc, had been used in England long before the December, 1888, patent had been applied for.

To satisfy those who may not be wholly convinced by the foregoing explanation, we may state that this "small reflector" is not such an important item in an alternating lamp as it may seem, as it can be left out and replaced by a larger one outside the globe, as, in fact, is done, in most cases.

Those public light measurements which are made now and again on alternating current lamps by means of small reflectors are made with new ones, or those in first class condition.

Experience teaches, too, that the enamel of a reflector placed inside suffers very much from the intense heat of the arc, especially if the current be over 12 ampères, and as a result of the reflector being burnt the light is reduced, while the larger enamelled reflector fixed outside the globe is not influenced by the heat, and the candle-power, therefore, remains unaltered. As a small inside reflector is the same price as a 500 mm. reflector (for outside) and a 600 mm. only slightly dearer, there is no absolute necessity to use the small reflector in question at all—as, besides the advantages of the larger reflector (used outside) above mentioned, it serves to prevent the globe from being broken.

Trusting this explanatory letter will make the position of ourselves and other manufacturers quite clear upon this matter, and apologising for trespassing upon your valuable space,

Pro **Koerting & Mathiesen** (*Leutzsch Leipzig*),
G. Braulik (*Sole Agent for Great Britain*).

[We have looked up the patent of December 14th, 1888, and claim 7 simply reads:—"The construction of the bridge piece, M, in the form of a disc, which is enamelled below and serves as a reflector, or the fixing of a reflector, R, to the bridge piece, M." We find no mention under this claim of "a small reflector inside the globe."—Eds. Elec. Rev.]

Local Action in Accumulators.

Will Mr. Epstein kindly say whether he is in a position to state how the cells he refers to would behave if, after charging, they were partly discharged before being put by for one, two, or three months? To diminish the local action which always, to some extent, occurs in the spongy lead plate, attention has to be paid to purity of material, the degree of strength of the acid, and the avoidance of conditions favourable to the production of persulphuric acid and its resulting peroxide of hydrogen.

To diminish local action in the peroxide plate, *i.e.*, that between the peroxide and the metal supporting it, we may either decrease the electromotive force acting in the local circuit, *e.g.*, by substituting platinum for lead, or, more practically, increase the resistance opposing the passage of the current in this circuit. The essential conditions for the production of a current being that the elements should be in contact with each other, and that each element should also be in contact with the electrolyte; and it being necessary for the production of the useful current (in the external circuit) that the peroxide should be (*a*) in perfect contact with its support, and (*b*) in perfect contact with the electrolyte, there is only one means available for increasing the resistance in the local circuit, viz., that of preventing, as far as possible, contact between the support (usually lead) and the electrolyte. This may be done by a dense and unbroken layer of peroxide on the surface of the lead support. If, in any form of lead accumulator, we can obtain this, and *retain* it by putting the cell carefully by when the layer is perfect, the local action becomes limited to the spongy lead element, and very favourable results can be shown in relation to the retention of charge. But, in most cases at least, these favourable results disappear when, by initially discharging the cell to the extent of 10 or 15 per cent. of its charge, the layer of peroxide becomes at certain points weakened or broken.

On a former occasion, I think, it was suggested that the Epstein cells compare favourably with others in their power of retaining charge. Possibly this is the case; but it is not at all obvious why they should differ in this respect from cells of the same type. In certain applications, this retention of charge, due to diminution of local action, is an important advantage.

Desmond G. Fitz-Gerald.

P.S.—I may some day have something to say in behalf of *inventors*, the "chief types" of whom are "mildly pilloried" in your last issue. There is one type you have not mentioned—a most unpopular one—the man who aims at improvement from a point of view which may be characterised as "abstract"; but which should be that of the general public, and is certainly not that of the man who merely wants to *sell*.—D. F.-G.

The Electromotive Phenomena of Physiology.

On December 28th last, you called attention to a paper on this interesting subject from the pen of Mr. E. Waymouth Reid, which appeared in *Science Progress*. Mr. Reid had critically reviewed the work of various experimentalists, and gave great prominence to a theory of Biedermann's on the subject of metabolic polarity.

It has been pointed out that Mr. Reid, in doing this, has apparently overlooked the fact that the theory had been previously advanced by an earlier investigator of considerable repute. In the *Medical Record*, of New York, under date September 3rd, 1892, Dr. Wm. Jas. Morton published an exhaustive article, setting forth in distinct terms the same theory accredited to Biedermann, whose views do not seem to have been made public till 1893.

Realising the importance of this theory in practical electrotherapeutics, you referred to Dr. Morton's work, and the laws he deduced, in a leader under date June 30th, 1893; but it seems only fair, now, to briefly reproduce some portions of his article bearing more particularly upon the physiology of his investigations.

He says: "A human body is a most active chemical laboratory. The general term of metabolism is applied to this ceaseless, while life exists, round of chemical changes; the terms anabolism to represent constructive metabolism, and katabolism to represent destructive metabolism. Anabolism is constructive; katabolism, the retrograde metamorphosis of tissue. These terms include, evidently, both morphological and chemical processes. The inter-relation of the two is inseparable. It would be impossible to say that either was fundamental. Without the cell substance there would be no chemical exchanges, and without the chemical exchanges no cell substances could be maintained."

After elaborating this point, and quoting various authorities, he proceeds: "Having built upon the view that the chemical activity of the living animal cell and its surrounding fluids may be responsible for the existence of animal currents, I propose two deductions: 1. A law of electro-therapeutics (which you referred to more particularly in your issue of June 30th, 1893). 2. A law of electro-physiology." In the development of this latter, he says:—

A theory is here offered which assumes that the oxidation going on in living organisms goes on in protoplasmic parts of the tissue, organised into voltaic couples, producing primarily only heat and electricity in proportions varying with the adaptability of these parts to produce more or less of one or of the other, according to conditions of circuit, and that the electromotive force thus generated forms at the negative element of the couple various complex chemical compounds whose decomposition produces not only physiological function, but is a second source of heat, and sets up the "current of action" or "negative oscillation." The primary electro-

motive force corresponds to the "current of repose" of nerve and muscle, and it is this primary current which in a previous section of this paper, I have proposed to use as an index and guide by means of which to apply a similar or counter-current, and thus to augment or diminish it, and as a consequence, augment or diminish the nutritive chemical exchanges of health or disease which generates it.

In the electro-physiological theory here proposed, the course of events would be: chemical affinity of katabolism in living organisms undergoes metamorphosis into heat and into electricity; the electricity sets up a second and local chemical reaction, which in turn, upon decomposition, undergoes metamorphosis into motion or change of form of the part (muscular contraction), action of nervous substance (possibly again change of form), secretion (elaboration of chemical products), and electromotive force, as in actual evidence in negative oscillation. It has often been maintained that physiological function was a direct transformation of chemical energy into function, due to the combinations of oxygen with the tissue; the theory now outlined implies that function is a transformation of chemical energy into function, due to the decomposition of complex chemical substances primarily formed by the electric action incident to katabolism. It assumes that the electromotive force primarily generated by the body actually does the work which makes function possible. Heat, the other initial product of oxidation, is concerned in warming the water in food, in warming the air in respiration, is evaporated in the lungs by radiation and evaporation at the skin, and need not here be further considered. Bertholon has classified chemical combinations as exothermic and endothermic, according as heat is evolved or absorbed during the reaction. We will extend this classification to the evolution and the absorption of electricity, viz., to a capacity for absorbing energy which may under proper conditions be transformed into electromotive force (as well as change of form and heat). That such an analogy is allowable is deduced from facts like the following:—If 1 gramme of zinc be dissolved in sulphuric acid, 1,670 heat units are set free; but it is also true that if the solution take place in a voltaic cell the evolved energy takes the form of an electric current, and 2,973 coulombs are set free. We may, therefore, perhaps be permitted to coin the words excelectric and endoelectric reactions, for whether the energy set free or absorbed during chemical reactions take the form of heat or electricity would seem to depend upon the mere mechanical arrangement of the chemical substances involved in the reaction.

The article then goes on to consider in detail the parallel between the action of the animal cell and that of the simple voltaic cell, and concludes with a summary, from which I extract the following:—

1. The mutual relations of the two elements and the electrolyte of an artificial voltaic cell are also the mutual relations of protoplasmic parts of living organisms during the process of living. *a.* The oxidation of the positive plate of the cell (the zinc) corresponds to the destructive or katabolic chemical exchanges producing waste products—carbonic acid, water, &c., and liberating energy. *b.* The hydrogen or other bases acting at the negative plate correspond to the constructive or anabolic chemical exchanges, and store energy. *c.* The decomposition of the electrolyte corresponds to the decomposition of the animal electrolyte (blood, lymph, and other fluids). *d.* Oxygen and hydrogen are referred to not as the only reaction agents, but also as types of their congeners engaged in the complex chemical exchanges of living organisms.

2. The initial action of the protoplasmic voltaic arrangement is to produce only heat and electromotive force or electricity. The latter is the "current of repose."

3. The origin and initiation of an electric current and consequent polarity cannot be from the electro-negative plate of the voltaic cell, but the current arises from the initial chemical action at the electro-positive plate, and therefore the starting point of living chemical exchanges is in the electro-positive plate—that is to say, is katabolic, oxidising, or destructive. At the negative plate energy is stored or rendered potential. The same is true of all the energies. As a consequence, *all metabolism, all chemical exchanges in living animal organisms are initially electro-positive*, and if an anabolic, constructive, or electro-negative focus is found by tests, it is not primary but accidental, and the result of the action of a conductively associated katabolic or oxidising positive plate.

H. Newman Lawrence.

New York, *January 30th*, 1895.

Alleged Defective Wiring at the Savoy Theatre.

I have been sent a cutting from your paper referring to an accident to a musical instrument in this theatre, and headed, "Alleged Defective Wiring at the Savoy Theatre."

As the paragraph is calculated to give an entirely wrong impression, and so to be damaging to this theatre, I will ask you to insert this letter, and the enclosed report from the head electrician of the theatre.

R. D'Oyly Carte.

Copy of report by Mr. George Lyons, head electrician of the Savoy Theatre, February 4th, 1895.

The slight mishap in question was caused in this way: The cover of a wall socket, or shoe, in the orchestra had been broken away by something having fallen on it. This was not noticed at the moment, and a musical instrument, belonging to a member of the orchestra, was laid in the corner and rolled on to the wall socket, so touching both of the terminal blocks where the wires lead in, and causing a short circuit. The fuse of the broken wall socket (a fine No. 36 tin wire), and the fuse on the cut-out protecting this circuit (a No. 22 tin wire), on which there were two more wall sockets, were blown out; so that in no case could anything serious have occurred.

Geo. Lyons.

Explosions.

Referring to Mr. B. H. Jenkinson's sketch in your last issue of the Review, I can gather from it that his ideas as to the importance of perfect ventilation and drainage are in the right direction, and I would simply suggest the erection of upright ventilators instead of flush with the pavement (to prevent their getting covered with slush, and frozen up), and the abandonment of the bare conductor system.

Arthur E. Gilbert, A.I.E.E.

P.S.—I see that Major Cardew advocates upright ventilators and forced draught, which entirely coincides with my suggestions in the Review 15 years ago.—A. E. G.

The Inventor: His Methods and Remuneration.

Whilst unwilling to emulate the literary method of the celebrated Artemus Ward, who used to label his effusions, "This is a goak," &c., so that he might not sustain the odium of being misunderstood; and, whilst regretting my incapacity to make myself clear to every order of mind, I will frankly admit that, had the title of my article in your issue of February 1st been less terse, or had I plainly announced what I hoped to convey, it might possibly have appeared patent to Mr. Andreoli, as, indeed, it probably did to the majority of your readers, that the "inventors" referred to were not such as this gentleman is at pains to defend. I am sorry that Mr. Andreoli feels himself aggrieved.

The Writer of "The Incriminated Article."

LEGAL.

The Cassel Gold Extracting Company *v.* The Cyanide Gold Recovery Syndicate.

The plaintiffs in this action claim that the defendants have infringed their patent rights, and on November 8th last, Mr. Justice Romer held that there had been no infringement. The plaintiff company thereupon appealed, and the hearing of the appeal was commenced yesterday before Lord Halsbury and Lords Justices Lindley and Smith, sitting in Court of Appeal No. 2.

Sir Richard Webster, Q.C., Mr. Moulton, Q.C., and Mr. Waters appeared for the plaintiff company, and Sir Edward Clarke, Q.C., Mr. Neville, Q.C., and Mr. Gardener appeared for the respondents.

Sir Richard Webster, in opening the case, said this was an appeal from the decision of Mr. Justice Romer, who held that there was not sufficient ground for the subject matter of the plaintiffs' patent, regard being had to previous anticipations. The question at issue was of immense commercial importance, and he should submit that the learned judge had not sufficiently applied the principle of law as laid down by the House of Lords and by the Court of Appeal, namely, that in order to destroy and invalidate a patent, you must get out of the prior anticipations such practical knowledge as would enable an ordinary skilled workman to carry out the process described in the patentee's specification. The plaintiffs' patent was of enormous commercial importance, and it was not denied that it was of the highest utility, and yet it was said that the knowledge was as old as the days of Faraday, and that the fact that there was such knowledge was sufficient to invalidate the patent. The process claimed by the plaintiffs was the recovery of gold from tailings or waste which for centuries had been allowed to go free. The amount of gold so allowed to go to waste was small in percentage, but very large in bulk, and some idea of the value of gold to be recovered from tailings might be obtained from the fact that, since 1887, by the employment of the plaintiffs' process, from £1,000,000 to £2,000,000 sterling of gold had been recovered. There was long ago the fundamental knowledge that gold could be recovered by means of cyanide of potassium, but that knowledge was never put to practical use.

Mr. Neville (interrupting) said it was denied that the plaintiffs' patent, by itself, led to any great useful result.

Sir R. Webster said he would undertake to make good everything which he had said with reference to the usefulness and novelty of the patent.

Lord Halsbury: What is objected to is the use of the words, "It is not denied."

Sir R. Webster: It is a fact that in the Court below, the utility of the patent was not disputed. I will not repeat the words, "it is not denied," but I shall claim, before the end of my argument, to have

made good everything which I have said. The learned counsel said cyanide of potassium had a dissolving action upon gold, upon the precipitate of gold, and upon gold leaf. That knowledge was old, but had not been turned to useful commercial purposes until the plaintiff company turned it to account. The whole of the anticipation suggested by the defendants was a mere paper anticipation.

Lord HALSBURY: I thought that aqua regia was the strongest dissolvent of gold?

Sir R. WEBSTER: Yes; but aqua regia is a combination, and if you tried it on the ore you would fail because it would be found that it acted also on the other metals—that was the great disadvantage of the combination. All that was wanted was to get the gold, and for that purpose a solution, but only a weak solution was wanted. Gold was previously extracted by two processes known as the amalgamation and the chlorination processes. The learned counsel then described these processes and passed on to the specification of the plaintiffs' patents, which he was reading when the Court adjourned.

BUSINESS NOTICES, &c.

Aberdeen.—The income and expenditure statement in connection with the electric lighting installation, for the 10 months ended December, has been submitted to the Council. The capital account brought out a balance at debit of £619, and the net revenue account a debit balance of £217. For the present quarter current is to be charged at 6d. per unit.

Arlecdon and Frizington.—The District Council have appointed a committee to secure the services of a thoroughly practical electrical engineer to examine the districts and ascertain whether sufficient motive power could be produced to light the district with electricity; also to prepare an estimate of the probable outlay for lighting the districts from water or steam power.

Belfast.—The jewellery premises of Mr. Sharman D. Neill, in Donegall Place, are now lighted by electricity. There are about 60 lamps, and the work has been carried out by Mr. C. C. MacCarthy, of Belfast.

Beverley.—"Seeing the great competition by the electric light which is threatened in certain large works, and the low price of mineral oil," the Town Council have decided to reduce gas by 5d. per 1,000 feet on March 25th, and a similar further reduction is to be made on September 25th next.

Bournemouth.—The formation of a local electrical association in connection with the Bournemouth Polytechnic was recently discussed at a meeting of students and others interested in electrical matters.

Bradford.—During a discussion regarding the advisability of increasing the present power at the Bolton Road Electricity Works, it was pointed out that altogether the present engines at the works totalled about 1,600 H.P., and that the demand necessitated the working of the existing machinery at high pressure. Not only was there no opportunity for this pressure upon the engines to be relieved, but in the event of a breakdown there would be a partial, if not a complete, stoppage of the works. It was further stated that there was an increasing number of applications for the electric light, and to meet these demands an increase of power would be necessary. The Gas and Electricity Committee ultimately decided to invite tenders from a number of firms for the supply and laying down of two new engines of 300 horse-power each.

Brighton.—When a member of the Council asked the other day if proper provision was being made to prevent main-box explosions at Brighton, the Mayor stated that with wires laid on the system they had adopted, explosions were impossible.

The electric light manager has been instructed to carry out the installation of the electric light at the swimming bath in North Road.

Bristol.—At the annual meeting of the St. Michael's Ward Liberals last week the Councillor for the ward said that the electric lighting work was proceeding very well. They had received orders for about 16,000 incandescent lamps and would soon see their way to orders for 20,000. He remarked that it was in the interests of the citizens that the light be extended as much as possible.

Cheltenham.—The Public Library Committee are anxious to have the electric light in the library and institution buildings, on the ground of safety to both the buildings and the books, yet they are unable to bear the expense of the undertaking. They applied to the Electric Lighting Committee of the Council to supply current free of cost for lighting the library, but this they cannot agree to, and have offered to light the library for £50 per annum, the Public Library Committee to undertake their own wiring. The charge for gas last year was £57 18s.

Coventry.—According to the contract for the equipment of the electric lighting works, the supply mains are laid on the east side of the street only in Burges, Crosscheaping, and Broadgate. This involves the trouble and expense of crossing the tramway line whenever it is necessary to connect a consumer on the west side. The Electric Light Committee have recommended that to avoid this a second supply main be laid on the west side of these streets, at the estimated cost of £203 5s. 9d.

Derby.—A hundred meters and five transformers have been ordered. Messrs. Siemens Bros. & Co. have made a constructional alteration in the arc lamps.

Edinburgh.—Prof. A. B. W. Kennedy, who is consulting engineer to the Corporation, was to have lectured on the electric lighting of Edinburgh, before the Edinburgh Literary Institute, on 6th inst., but owing to indisposition, he was unable to attend. Mr. Monkhouse, the resident engineer, however, read the lecture.

Glasgow.—Some of the councillors do not like the manner of lighting some of the tramcars, one of them thinking it "hideously ugly."

Inverary.—We understand that the electric light installation at Inverary Castle is being extended.

Killarney.—We recently mentioned the dispute between the Electric Light Company and the Town Commissioners, the former party claiming two sums for the electric lighting of Killarney. Judgment has now been given in favour of the Electric Light Company. Notice of appeal was given.

Liverpool.—We understand that the special meeting which was announced for March 6th, for the confirmation of the resolution of the Lighting Committee, recommending application for powers to supply electricity to private consumers in all parts of the city, is not now to be held, the Council having declined to confirm the resolution.

It is understood that the Electric Lighting Committee will now proceed to seriously open negotiations for the purchase of the undertaking of the Liverpool Electric Supply Company, Limited.

London.—Messrs. Drake & Gorham have been successful in obtaining the contract of the electric lighting of the North Eastern Railway Company's new offices in Great George Street, Westminster.

Manchester.—The City Council have decided to abolish the meter rents and reduce the price of gas from 2s. 6d. to 2s. 3d. per 1,000 feet at the end of the current financial year. They have also resolved to reduce the charge per unit for electric current from 8d. to 6d. as from March 31st, 1895.

Messrs. Lowcock, Hill & Co. have fitted up the premises of the Arts Club with the electric light.

Montrose.—The Harbour Trustees have resolved to take no action regarding the provisional order being applied for by the Scottish House-to-House Electric Light Company.

Nottingham Telephones.—The National Telephone Company are making improvements in their system at Nottingham.

Nuneaton.—It is stated by a local paper that, in consequence of the failure of the large gas engine at the school electric lighting station, the machinery is, for the present, at a standstill.

Oldham.—A Councillor the other day asked that a balance-sheet should be issued with regard to the working of the electric light. The chairman of the Electric Light Committee, in reply, said that a balance-sheet would have been issued before now, but certain of the machines were unsatisfactory, and until they were passed by the engineer, nothing could be done in the way of publishing a balance-sheet.

Ossett.—The tradesmen are dissatisfied with the present high price of gas, and some of them the other day suggested the purchase of the gas works by the Corporation, or that an electric lighting company be invited to commence operations in the district. Ossett and Horbury tradesmen are to meet together again to discuss the matter.

Queenstown.—Mr. Robert Hammond the other day appeared before a special meeting of the Commissioners, and gave information regarding electric lighting installations in other towns. He was afterwards asked to send in a written report to the board. A local paper says he is to be consulting engineer if the scheme is adopted.

Salisbury.—The Council has consented to the application from the Salisbury Electric Light and Power Company, Limited, who intend applying for a provisional order.

Stafford.—The Town Council intend charging 8d. per unit for current for ordinary lighting purposes, but to reduce the price to 4d. for all current consumed during each year beyond that necessary for an average daily use of two hours of maximum demand.

St. Olave's.—The Board of Works have resolved to consent to the provisional order of the County of London and Brush Provincial Electric Lighting Company, subject to certain clauses being inserted.

Tiverton.—So far as the Town Council is concerned, electric lighting has been placed upon the shelf, and is likely to remain there for a long time. Last week, by 19 votes to 2, they resolved to purchase the gas works of Messrs. Heathcoat & Co. for £20,000. One member voted for the resolution because it would hang up "that horrid electric light question." Tiverton councillors are much behind the age, and in 20 years or so, when there will doubtless be a prosperous electric lighting station worked by a private company, they may regret the step just taken.

Tunbridge Wells.—At the Ratepayers' Association meeting the other day, it was stated that the state of the weather was responsible for delay in the erection of the electric lighting building. According to the contract, it should have been completed by the end of February, but this is not now to be expected.

Walsall.—The Trades' Council, who are championing the cause of the unemployed of the town, have expressed their strong disapproval of the action of the Town Council in accepting the tenders of contractors outside Walsall for work in connection with the electric lighting installation.

Wandsworth.—Upon the recommendation of the General Purposes Committee, the Vestry have resolved that in the event of the electric lighting company commencing works involving the construction of transformer chambers under the public way in this district, or giving notice to commence such works, the solicitor be instructed to apply for an injunction to restrain the company from proceeding therewith, and to obtain such evidence as he may consider necessary in support of the application.

Worcester.—The total loss on the electric lighting works for the first quarter is stated to be less than £100. It is hoped that by next winter the installation will be working at a profit. The Lighting Committee have expressed dissatisfaction that the builder's extras in connection with the erection of the generating station amounted to between £4,000 and £5,000. The matter is to be fully inquired into.

African Telegraphs.—A *Financial News* correspondent says that the telegraph line from Buluwayo to Charter is making rapid strides. It is anticipated that the connection will be completed within a couple of months. The Portuguese at Tete have agreed to utilise the Transcontinental Telegraph Company's standards for their wires, thus ending the dispute up there.

Bates *v.* National Telephone Company.—In the Chancery Division of the High Court of Justice on Thursday the 7th inst., Mr. O'Leigh Clare stated before Mr. Justice North that this was an action to restrain the company from erecting a standard on the plaintiff's house. The company had agreed to remove the standard, to make everything good, and to pay the costs of the action. It had further been agreed that the motion should be treated as the trial of the action. Counsel for the company appeared and consented. Mr. Justice North made an order in the terms agreed upon.

Business Announcement.—Mr. George Offor informs us that he has opened an office at 78, Mansion House Chambers, Queen Victoria Street, E.C., where he will continue the business of contractor for the supply of electricity.

Catalogues.—Messrs. Elliott Brothers, of St. Martin's Lane, W.C., have brought out an excellent catalogue of their manufactures which include electrical, optical, engineering, and mathematical apparatus. There is at the commencement a useful business telegraph code, including a code table of dates (one word for each day in the year) and a code table of numerals up to 252. This catalogue is about as neat a one as we have seen, and it testifies to most careful printing and general compilation, and the illustrations are likewise very good indeed. The details are so arranged that from a glance the price of any article can be easily traced, and anything mentioned in the catalogue can be found at once by the aid of its number. Altogether there are 1,405 different articles particularised, and a great number of them are neatly illustrated. Over 20 pages deal with galvanometers, 18 with resistances and rheostats, 6 with electrometers, &c., 9 with keys and switches, 5 with standard cells and batteries, and various other apparatus, including testing accessories, chronographs, and other recording instruments, and general engineering instruments, also Lord Kelvin's standard balances, &c., are described. We have great pleasure in recommending this catalogue to the attention of those using and otherwise interested in the apparatus described therein.

An illustrated price list of electric bells, indicators, telephones, and a variety of other electrical apparatus, has been brought out by Messrs. Mason, Wathes & Brown, of Rutland Street, Leicester. The book abounds in illustrations, and, altogether, it is a neat little list. The covers are printed in several colours.

Messrs. H. F. Joel & Co. have published a very good catalogue. In addition to the description of electrical fittings and accessories usual in catalogues of electrical firms, there is some very useful information, showing how an electric lighting installation should be planned, and some points to be considered regarding electric light wiring. There are also details of great service under the following headings:—Table of fuse wires, units of electrical measurement in every day use, comparative table of gas and other lights with the electric light, selection of a turbine, and the measurement of water. Under the last heading are some handy instructions, and by following these out anyone who has any water-power in their possession can easily measure the supply. In the following pages are given instructions for starting and working Joel dynamos and motors and the Pilsen-Joel arc lamps, instructions for erecting and working storage batteries. The printing and illustrations are very well done. We have no hesitation in recommending this catalogue to the notice of our readers, as we believe it will be found very serviceable.

"Celluvert" Fibre.—This material is being used by Messrs. David Moseley & Sons, of Manchester, for the manufacture of hydraulic cups and hats. A pump cup, which is before us, made from "celluvert" fibre, is a specimen of the great strength and wearing properties possessed by the material. Some tests that have been carried out prove this fibre to be far superior to leather for such purposes. Two advantages claimed are that it can be used with any temperature, and will stand the highest pressure.

Clarke, Chapman & Co., Limited.—This company during the year 1894 carried out a large number of electrical installations, both for lighting and other purposes. Among the land installations are colliery, vicarage, shipyard, and ironworks lighting, large electric cranes, &c. Special electric galvanising plants were supplied to the following:—Sir W. G. Armstrong, Mitchell & Co., Limited. Naval Construction and Armaments Company, Hanna, Donald & Wilson, Palmer's S. B. and Iron Co., H. J. Waterston & Co. Large electric cranes, &c., were supplied to Messrs. Swan & Hunter, of Wallsend. In addition to the above, they have supplied some large generating plants and switchboards for Messrs. Swan & Hunter, and a large number of combined engines and dynamos, and belt-driven dynamos for installations not carried out by them, as well as a large number of search light projectors of various types, &c. Amongst other important installations they have in hand, are the lighting of H.M.S. *Powerful*, *Juno* and *Doris*, also the lighting of a large number of other vessels. The company have had very considerable experience in electric galvanising plants. In the large plant put down at the Naval Construction and Armaments Company, at Barrow, the tank is upwards of 20 feet long by 7 feet deep and 6 feet wide, and is capable of galvanising about 350 feet of iron plate per hour. This is driven by one of the company's improved gas engines (Butler's patent), which is specially arranged for driving electric light machinery. The dynamo is a 4-pole machine capable of an output of 4,000 ampères at a pressure of about 5 volts. This plant has been in use for about 12 months, and has, we understand, given every satisfaction. The work done has been in connection with the plates and frames for the new torpedo boat catchers, and also in galvanising the boiler tubes for these boats, as galvanising affords an exceedingly delicate test as to the perfect soundness of steel tubes. At Messrs. Hanna, Donald & Wilson the same company have also put down a plant capable of doing 250 feet of plate per hour for the same purpose, and which has been constantly in use ever since, and is used for other work besides this. At Messrs. Palmer's, at Jarrow, and Messrs. Armstrong-Mitchell's, at Elswick, the plant which has been put down has given perfect satisfaction, and is in constant use. The plant installed at Messrs. Waterston's, of Sunderland, is intended for plates, frames, and general work, and Messrs. Clarke, Chapman have also in hand a plant of the same size as Messrs Armstrong-Mitchell's for J. Samuel White, Esq., shipbuilder, of Cowes, Isle of Wight. The company has a very simple method of suspending the plates and other articles in the solution, which is found to be perfectly satisfactory in every respect, and all plates and articles that are put in, come out with a white hard deposit entirely free from spots, which would indicate a soft and non-adherent deposit.

Electric Transmission of Power.—In our notice of Messrs. Johnson & Phillips's pamphlet, describing the Sheba Mine plant, we omitted to state that the "Victor" turbines are in use, and were supplied by Mr. F. Nell.

Four-Coil Thomson Galvanometer.—The high resistance apparatus shown in the illustration is being made by Messrs. Nalder Bros. & Co. It has been got out for the use of engineers and others who want an instrument of high sensitiveness, but do not

require the expensive design and lacquered brass case of the old patterns. All the necessary work is thoroughly good and sound, but there is no unnecessary adornment. The resistance is about 5,000 ohms, and the sensitiveness is as great as in the old patterns. The instrument stands on a solid brass base, which can be screwed straight on to the table or on to a wall bracket, while the levelling is done

much as in a theodolite. The control magnet is of the scissors type, and allows the time of swing to be adjusted with great care. The window is at an angle to avoid "ghosts," and the needle is shielded from electrostatic disturbances.

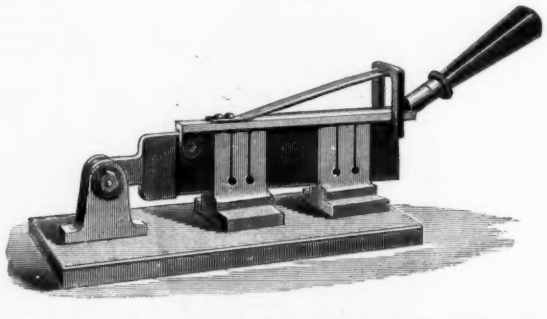
Dissolutions of Partnerships.—The partnership heretofore subsisting between D. W. Paine & G. Thompson, carrying on business as electrical engineers at 115, Queen's Road, Brighton, under the style or firm of Paine & Thompson, has been dissolved by mutual consent, as and from February 1st, 1895. All debts due to and owing by the late firm will be paid by G. Thompson, who will continue to carry on the business in his own name.

The partnership heretofore subsisting between P. Rosling and F. J. A. Matthews, carrying on business as electrical and mechanical engineers at the Trafalgar Works, Trafalgar Street, Bradford, and at Porter Street, Hull, has been dissolved by mutual consent as and from the 31st day of August, 1894. All debts due to, and owing by, the late firm will be received and paid by P. Rosling.

Gas v. Electricity at Chester.—In addressing the shareholders of the Chester United Gas Company, the other day, the chairman said there was no doubt that electric lighting during the last 15 years had made very great strides, but there was a very strong opinion amongst engineers competent to judge upon the matter that there was not likely to be any great advancement made in the means and expense of supplying electric lighting. Although the strides made by the electric light had been very rapid and continuous, there was a very strong opinion that the improvements in manufacturing the electric light were pretty well exhausted. He had never seen a single case of a gas company being permanently injured by electric lighting, or the shareholders going short of their dividends by the competition of electric light. They had nothing to fear from a fair competition—by which he meant the charging of capital account to the cost of electric lighting paid by the consumer, the manufacturer, and the supplier of it. If that was fairly done, the lowest estimate that could be formed of electric lighting was that it would be at least double that of the present price of their gas. In other words, they could not get the same lighting as was now given, by the electric light, without doubling the expense to the consumer. . . . It was for the shareholders and general public to see that a fair price was charged for electric light to those who consumed it, and not that the general ratepayer should be saddled with anything extra in order to supply what was undoubtedly a luxury to a few who liked to have it.

Main Box Ventilation.—We have received from Messrs. Peirson & Co., of Fenchurch Street, a sheet giving a number of sectional and other views in explanation of their "simplex" system of manhole ventilation, which we have already described in these columns.

New Quick-Break Switch.—The switch for high tension current and railroad work, illustrated below, was recently brought out by J. Grant High & Co., Philadelphia. In designing this device the inventor, George T. Evanson, had in view the object of making a switch with a quick break and one in which the contact between the blade and clips remains intact, until by lifting the handle all the resiliency in the spring is stored up, then the handle piece, coming in contact with the head of the yoke, gives a dead lift, releasing the hold the clips have on the blade, and causing the blade to spring out



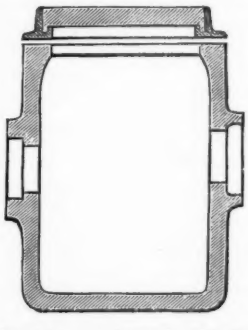
In this way a quick and long break switch is effected. The handle piece, which is made of steel, is hinged in the back of the blade and extends through and snugly travels in the yoke, giving the additional strength to the blade and insuring it from damages arising from carelessness on the part of the operator. This application of the spring can be used either on single, double or triple pole. This style of switch is at the present time in use on the Roxborough & Incline Plane Railroad and the Pottstown and Ringing Rocks road. The *Street Railway Gazette* says that Messrs. J. Grant High & Co. are fitting with these switches several large railroad boards, now under way of construction in their shops.

New Switch.—Mr. A. Slatter, manager of Messrs. Julius Sax & Co., has brought out a little switch of the same pattern as his ordinary tumbler, but with spring contact. The features of the switch are the plunger movement, which makes and breaks contact as soon as it passes the dead centre, and the peculiarity of construction of the spring contact. This is so made, that with ordinary usage, the contact is practically a solid one, with the advantage that it is cheaper. We are informed that the company have already a good demand for these switches, but we think it would be much improved if it were of more robust construction.

Revolving Switch Lamp-Holder.—The lamp-holder illustrated herewith is made by Messrs. Evered & Co., Limited, of Birmingham. It is switched on and off by turning an ebonite

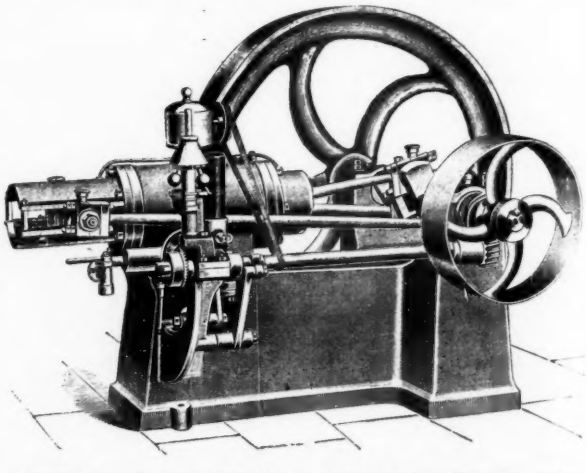
milled ring, and it has a sharp break. The advantages claimed are, no keys projecting, neatness, and its small size, being no larger (or very slightly so) than an ordinary holder. The action of the switch is very easy, and wiring is also simple.

Stoneware Street Main Boxes.—The Glenboig Union Fire Clay Company, Limited, of Glasgow, are introducing the "Glenboig" system of patent stoneware street boxes for electric mains. The illustration shows a sectional view of one of these boxes,



which are manufactured in one piece, glazed both inside and outside, and are claimed to be absolutely gas and water tight. The dangers attending the use of brick-built boxes are said to be completely removed where the stoneware boxes are used. They are made in various forms and sizes, according to requirements.

The "Duplex" Patent High Speed Gas Engine.—This engine which is shown in the illustration below is made by Messrs. Scott Bros., of Halifax, and is said to be specially suitable for electric lighting purposes, and is made, we are informed, in all sizes from ½ to 2,000 I.H.P. The gas engine differs from the usual form in that two pistons are employed working in one cylinder and on to one crank-shaft by means of one centre and two side connecting rods. The angle at which



the cranks can be set may be varied so as to secure that both cranks are not on their centres simultaneously, but one of them at the point of explosion and always in a position for effective work. These are very desirable features where heavy and constant work at high speeds has to be performed. The duplex arrangement permits of the engine being run at a much higher speed than is possible with the ordinary arrangement. Moreover, the stroke of the engine being divided between the pistons, double the number of revolutions can be run with the same speed per piston as obtains in a single-crank engine, and the power of the explosion at the same time is utilised with the greatest rapidity. The value of this feature is apparent from the fact that the initial pressure of from 300 to 320 lbs. per square inch, in the case of the smaller engines, is reduced almost by 33 per cent. in some instances before the piston has travelled more than one-twentieth of its stroke, the final pressure being nearly as low as 20 lbs. per square inch. The explosions are regulated by the length of the ignition tube which is adjusted by either shortening the tube or raising the Bunsen burner. Gas and air are admitted to the cylinder by a combination valve, and there is only one valve box, which is common to both the admission and the exhaust valves. Both these valves are opened by means of a double cam actuated by the side shaft, which is driven by skew wheels from the crankshaft. These wheels run in a specially constructed oil bath and guard, capable of being quickly removed to allow the worm wheels to be examined without interfering with either the pulley or the fly-wheel. The sensitive action of the governor, combined with the steady impulse given, enables the engine to run at a remarkably even speed. The governor is readily adjustable to any required speed, even when the engine is at work. The lubricating arrangements are very complete and effective, the cylinder being lubricated positively by means of a belt being driven off the side shaft actuating the lubricator, the remaining oil cups being automatic in their action. With regard to the consumption of gas, the makers claim that the "Duplex" gas engine consumes from 15 to 25 per cent. less per B.H.P. than ordinary single-crank engines, that is to say, 15 cubic feet per brake horse actual per hour, or less than ½d. per actual brake horse per hour. An advantage that is claimed for this engine is that the explosion taking place between the two pistons balances it, and this allows it to be run at much higher speed, with less vibration, and less wear and tear than ordinary single crank engines. In the engine of 200 I.H P., an advantage that is claimed is that it explodes twice in three revolutions as compared with once in two revolutions in other engines.

The Edison-Bell Phonograph Corporation v. Hough.—On Tuesday an application was made on behalf of the plaintiff company before Lords Justices Lindley and Smith, by way of appeal from an order in Chambers by Mr. Justice Stirling. Mr. J. C. Graham, for the Corporation, said the action was brought to restrain Mr. Hough from infringing the plaintiffs' patent rights in phonographs, and in Chambers the learned judge made an order for a commission to issue to America to examine Mr. Edison, and five or six other witnesses. The plaintiffs objected that this was unnecessary, as Mr. Edison had already given evidence in another action, and he could not now add anything of value which experts in this country could not give. The expense and delay of sending a commission would be very great. Their Lordships came to the conclusion that sufficient reason had not been given to justify their interference, and they dismissed the application.

Transformer Chambers.—St. Luke's Vestry has unanimously decided to support the Vestry of St. George the Martyr, Southwark, in their proposed petition to the Board of Trade against the laying of transformer chambers in the main thoroughfares of the Metropolis. We fail to see the use of this petition. The Board of Trade has already given the decision arrived at as the result of the conference recently held.

Now Ready.—The Universal Electrical Directory. This well-known Red Book can now be purchased by those who had not previously placed their orders. It contains a total of 20,958 distinct names of individuals and firms, being 2,500 more than were contained in the book for 1894. In addition to the new names incorporated in the present issue, much financial information has been added; the telegraphic addresses and telephonic numbers are given; and the total of pages added to the work is 80 as compared with that of 1894, making in all about 866 pages entirely of directory matter. The price, as before, is 4s.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bradford.—Tenders are shortly to be invited by the Gas and Electricity Committee for two 300-H.P. engines for the purposes of extensions.

City of Norwich.—February 21st. Tenders are invited for the installation of electric lighting fittings and conductors at St. Andrew's and Blackfriars Halls. Specification and particulars may be obtained on application to Mr. Arthur E. Collins, A.M.I.C.E., city engineer, Guildhall, Norwich.

LOSED.

Belfast.—We learn that the Great Northern Railway Company of Ireland have placed with Mr. Maurice Pitman, of Sandymount, the contract for lighting the goods yard at Belfast with four 2,000-C.P. arc lamps; also for lighting the new dining car now in course of construction.

South Shields.—At a meeting of the Town Council, held on February 6th, 1895, the following tenders were accepted:—

Boilers and Pipes.—Black, Hawthorne & Co., Limited, Gateshead	£1,809	0	0
Pumps.—Hy. Watson & Sons, Newcastle ...	905	14	3
Engines and Alternators.—S. Z. de Ferranti, Limited, London	8,003	0	0
Cables and Trenching.—India-Rubber & Gutta-Percha Company, Limited, Silvertown, Essex	4,846	0	0
Arc Lighting.—S. Z. de Ferranti, Limited, London	793	11	0
Meters, &c.—This section to stand over for the present.			

The specification for this plant was issued last September. From the first it was determined by the Borough Electrical Engineer, Mr. Jos. A. Jeckell, that the plant to be accepted was that which gave the best value for the money, and not because the tender happened to be the lowest. In order that he might have the means of comparing the respective merits of the different plants offered which fulfilled the spirit of the specification, irrespective of minor details, firms tendering were requested to submit, along with their tender, drawings as per list appended to the specification, and, for this reason, the time allowed during which tenders would be received was much longer than is usually the case. The leading firms submitted the drawings asked for, as it was evident to them that the plant would be considered on its intrinsic construction merits. The tenders accepted were those which, in the opinion of the Borough Electrical Engineer, offered the best value for the money; and this opinion was unanimously endorsed by a sub-committee, consisting of four practical mechanical engineers, subsequently appointed to report to the Electrical Lighting Committee on the tenders, and their report was unanimously adopted by the Council. It was decided to put down a rather larger plant than was at first thought of, and the engineer's estimate for this was unanimously accepted, and it was resolved that application be made to the Local Government Board for leave to borrow £28,000.

NOTES.

Obituary.—We learn with regret of the death of Rudolf Eickemeyer, which happened at Washington on 23rd ult. Mr. Eickemeyer, who was born in Bavaria, settled in the United States in 1850. After trying his hand at various general inventions, from which he derived immense wealth, he turned his inventive genius to account in the direction of electrical science, his motors and dynamos being now known all the world over. We understand that one of the earliest direct-connected sets of plant installed for lighting railway trains consisted of a Brotherhood engine and an Eickemeyer dynamo. Later, Mr. Eickemeyer co-operated with a Mr. Field in developing an electric railway system, which was in due course manufactured by the Eickemeyer-Field Company. For some years the deceased gentleman worked with Mr. C. P. Steinmetz (whose papers have from time to time been published in the Review), especially in his work on alternating current apparatus. Mr. Eickemeyer leaves a wife and six children.

The Late Mr. G. E. Preece.—Mr. H. A. Henderson, of Manchester, writes as follows:—"I have read with interest the notice of the late Mr. G. E. Preece, but observe that the period of his life from 1878 to 1884 is not mentioned. It was during a portion of this period that I was intimately connected with Mr. Preece, then in the employ of the Manchester Edison-Swan Company, for whom he carried out some very useful work in connection with what was, I believe, the first central lighting station in this country. Among other things, Mr. Preece brought into practical use a choking resistance for incandescent lamps, which was employed at the Theatre Royal in this city. I have a vivid recollection of the indefatigable energy he displayed in tackling and surmounting the difficulties he met with in connection with this work. About the same period he also designed and made a Wheatstone bridge for measuring the resistance of a lamp while in a state of incandescence. Perhaps these few additional details of a type of electrical engineer, of which Mr. Preece was a fair representative, and whose members are unfortunately rapidly disappearing from amongst us, may be of interest to some of your readers."

The Northern Society of Electrical Engineers.—At the ballot for new members on February 11th, the following were elected :—W. F. D. Duncan, Wigan ; A. B. Mountain, Huddersfield ; John Platt, Roubaix, France ; R. O. Ritchie, Leeds ; R. Shaw, Manchester ; Charles Turner, Salford.

The Pacific Cable.—At the Inter-Colonial Postal Conference held at Hobart on 2nd inst., the Pacific Cable question was discussed. Mr. Thynne moved a resolution in favour of the construction, working, and maintenance of a cable through British territory and under British control from Vancouver to Australia, to be undertaken by the Governments of Great Britain, Canada, and Australasia. As a joint national work, the cost should be borne equally by the three countries. The route proposed was from Vancouver by Neckar Island to Fiji, and thence to Caloundra, in Queensland. If Neckar Island could not be placed under British control, the route would be by Fanning Island instead of Neckar Island. The motion further advised that a commission of the three countries should be appointed to conduct the financial arrangements, and that the Government of Canada should be requested to continue their good offices in promoting the undertaking. Mr. Cook moved an amendment re-affirming the desirability of a Pacific cable, and urging the Governments to take steps in the matter. The amendment was carried. In regard to the cable guarantee, Mr. Ward moved that Victoria should reconsider its withdrawal. The conference went into committee to confer on this point. As the result of the consultation Mr. Ward moved before the conference that the colonies should agree to guarantee an international revenue to the Eastern Extension Telegraph Company up to £227,000 per annum, making up any loss below that amount, provided it did not exceed £10,000, also to guarantee a revenue from the New Zealand cable of £20,000, making up the loss if it did not exceed £9,000, provided the rates were not higher than at present, the agreement to be from year to year, and terminable on two months' notice. The arrangement is to be referred to Sir John Pender for approval.

"One of the Tenderers," writing to the *Standard*, is not at all pleased or satisfied with the statement that the Canadian Government has forwarded to the Australian Governments a revised offer on the part of one of the tenderers for the construction of the cable, the revised offer being for a cable having a speed of 15 or 18 words per minute, instead of 12 words per minute, as asked for by the Canadian Government when tenders were invited. The question naturally arises in the mind of the writer as to whether it is fair that one particular firm should be allowed to revise their tender without the other competing firms having a like option of doing so.

A Reuter's telegram which appeared in the papers of last Monday, announces that on the 9th inst. the United States Senate, by 36 votes against 25, voted a sum of $500,000 to begin the laying of a telegraph cable between the West Coast of the United States and Hawaii, at the same time authorising the President to enter into a contract for the execution of the entire work at a cost of $3,000,000. The distance overground from San Francisco, which is likely to be the landing at the American end, to Honolulu, in Hawaii, is 2,090 nautical miles, and some 2,400 miles of cable would therefore be required. Only about 100 miles of this would lie in shallow water, the depths for almost the entire distance being between 2,500 and 3,000 fathoms. A large number of soundings have been taken over the route by various American men-of-war, and the bottom appears to be a favourable one consisting of mud and ooze. There is however a shallow rocky patch at some 600 miles from San Francisco showing that even in basins of great depth and extent too much reliance should not be placed on the bottom being regular. The distance overground from Honolulu to Samoa is 2,260 miles ; from Samoa to Fiji is 643 miles and from Fiji to New Caledonia is some 800 miles, so that when the Hawaii cable is laid there will be an uncompleted length of 3,700 miles.

A despatch from Washington dated 10th inst. states that the Bill for the incorporation of the International Pacific Cable Company to lay a cable between California, Hawaii and Japan has been introduced in the House of Representatives.

Fire.—At the Princess Theatre, Melbourne, a few weeks since, there was a small fire caused by the fusion of electric wires. Happily the fire was detected before more than £5 worth of damage was done.

Incandescent Gas v. Electricity.—The last report of the Dovor Gas Light Company says that the discovery of the incandescent gas system of lighting has come at a propitious moment; for "although in itself no additional source of profit, it will be a most valuable assistance to the company in the approaching competition with the electric light, which it rivals in brilliancy and power, while its cost, both in respect of supply and fittings, bears no approximation to the expense of lighting by electricity."

The South Shields Tenders.—We congratulate most heartily Mr. Jeckell, the borough engineer of South Shields, on his recent adjudication upon the lighting tenders. He has not been led away by low prices, and his example is one that could be well followed by all borough engineers. We are aware that it requires a good deal of moral courage for a young engineer to insist on first-class plant, without regard to price ; but if such a policy were to become more general, nothing but good would result to the industry.

Post Office and the Telephone.—In the House of Commons, on 7th inst., Mr. A. Morley stated that, as the result of the deputation which he had recently received from the London County Council and the Association of Municipal Corporations, some of the objections which were felt to the effect of the agreements between the Post Office and the telephone companies had been removed. The agreements merely embodied the temporary arrangements signed in 1892, in accordance with the report of the House of Commons Select Committee. The Government did not consider that any advantage would be gained in referring the matter to a fresh Parliamentary Committee.

The Institution of Electrical Engineers.—By the kind permission of the council of the Society of Arts, an extra meeting will be held at their rooms, No. 18, John Street, Adelphi, W.C., on Thursday, February 21st, 1895, at 8 p.m., when the following paper will be read: "Propagation of Magnetism in Iron," by Dr. John Hopkinson, M.A., F.R.S., Past President (illustrated by experiments).

At a students' meeting, to be held in the library of the Institution, 28, Victoria Street, on Friday, February 22nd, at 8 p.m., the following paper will be read by Mr. E. E. Hoadley: "The Efficiencies of Dynamos and Motors and their Measurement."

Electric Lighting Regulations.—In the House of Commons on 7th inst., Mr. Bryce, replying to two members, said :—"Inquiries have been held into the causes of the recent explosions in street boxes in Cannon Street, the Euston Road, and Southwark. The reports shall be laid upon the table. The electric lighting regulations of the board for securing the safety of the public provide that all street boxes shall be efficiently protected against any accumulation of gas or water, and the board are earnestly pressing upon electric lighting companies the necessity for full compliance with these regulations. It is most desirable that the gas companies should adopt the best means at their disposal to detect and remedy any defects in their mains, and I am now taking steps to call their attention to the matter."

Lectures.— Before the East of Scotland Engineering Association last week, Mr. Mathew Buchan read a paper on "American Electrical Industries." He emphasised the advantages America enjoyed in having few restrictions placed by the Government upon new enterprises.

At the Picton Lecture Hall on 6th inst., Mr. F. G. Baily, M.A., lecturer on electrotechnics at University College, Liverpool, lectured on "Electricity in Manufacturing Processes."

On Monday 4th inst., Mr. William Noble delivered a lecture to the Ferryhill Free Church Literary Association on "Practical Applications of Electricity in its Relation to the Electric Light, the Telephone, and Telegraph."

In Aberdeen Free Church College Hall on 9th inst., Professor M'Kendrick, of Glasgow University, lectured on "The Physiological Phenomena of the Electric Fishes."

Marriage.—On 13th inst. Mr. J. D. F. Andrews was married to Miss Amy Beatrice McKrill, at Fulham Parish Church, the Rev. W. C. Muriel (rector) officiating. We offer Mr. Andrews our sincére congratulations.

London-Paris Telephone.—The Postmaster-General, in answer to Mr. Henniker Heaton in the House on Tuesday, said during business hours the telephone between London and Paris was in constant use, so that there could be no doubt there was a demand on the part of the business classes for such communication. He could not see his way to reduce the rate for a three minutes' conversation from 8s. to 3s. as had been suggested.

Electroscopes in Lecture.—The following reply to Prof. Lodge's letter, which we reproduced last week, has been sent to *Nature* by J. Reginald Ashworth of Owens College, Manchester:—"The electroscope which Prof. Lodge proposes to use to indicate positive and negative potentials by different movements of the leaves (see p. 320), has the disadvantage that (assuming the case to be charged negatively), if too large a negative charge be given to the gold leaves they will diverge, and the inference will be that the potential is zero or positive, neither of which is the truth. For the purpose Prof. Lodge has in view, a Bohnenberger's electroscope would indicate more clearly positive, negative, or zero potential. Instead of the two dry piles, the inner and outer coatings of a charged insulated Leyden jar connected to two knobs, one on each side of the single gold leaf, might be substituted."

The Madagascar Cable.—The French Telephone Company's steamer having on board the submarine cable, left Calais some days ago, and will proceed at once with the work of laying the cable to Madagascar. At the last meeting of one of the telegraph companies, Sir John Pender made some remarks regarding the action of those superintending the arrangements for laying this cable. Sir John's company tendered for the work, and their estimate turned out to be lower than that of French cable companies. Notwithstanding this, however, the contract was divided between two French companies. Sir John has not great faith in the abilities of French cablemen, and he even now lives in the hope that the contractors may have to seek English assistance in laying the present cable. According to his statements, it would appear that his company's ships are already on the route prepared for action whenever the failure he anticipates occurs.

Clydebank v. Birmingham.—A letter from Alex. M'Donald in the Glasgow *Evening Citizen* of February 7th is a curiosity. He seems to be one of the Clydebank brothers who, about two months ago, were going to revolutionise the electrical industry with a wonderful primary battery, and he makes comparisons—such funny ones—between his own precious cell and that of Walker-Wilkins. His working of Ohm's law, by which he arrives at the E.M.F. of the Walker-Wilkins element (one-tenth of a volt) is too stupid even for a schoolboy, as he leaves out of the question the external resistance which Prof. Jamieson had in circuit, and his other calculations are even more foolish. He also either deliberately, or in ignorance, misquotes Prof. Jamieson, when he states that the latter "told us that any person using copper sulphate and copper in a battery, could not generate a horse-power for one hour at less than 30 times the cost of a steam engine and dynamo; the curious part of this being that we do not use copper." Prof. Jamieson said "zinc, sulphate of copper, and copper," and his contention was perfectly correct, even if we give the Clydebank youths the exciting fluids and depolarisers, whatever they may be, free of cost. Two and a-half pounds of coal will give one horse-power-hour, and it will practically require a consumption of 2½ lbs. of zinc at least to produce the same result from a primary battery. Let Mr. M'Donald compare the prices of coal and zinc, and he must at once withdraw the assertion that he and his brother can, *if they wish*, generate one horse-power-hour at less than half the cost of a steam engine and dynamo. Such letters as his are excellent fooling, but they are not scientific. People ought to be taught that there is only a definite amount of energy stored up in a pound of zinc. We observe that in a letter to the Glasgow *Evening Citizen* of the 9th inst., Prof. Jamieson corrects Mr. M'Donald's statements.

Opening of Electricity Works.—The Blackburn Corporation Works are to be opened on Monday next.

Royal Visit to the G.P.O.—Mr. W. H. Preece, C.B., and Mr. H. C. Fischer (the Engineer-in-Chief and the Controller of the Post Office Telegraphs), last Friday conducted the Prince and Princess of Wales, the Duke and Duchess of York, and others, over the Central Telegraph Office.

Scottish House-to-House Electricity Company.—We are informed that Mr. Angus McLeod, having resigned his position as managing director of the above company, Mr. A. J. Lawson has been appointed by the directors as the engineer and manager. Mr. Teague remains resident engineer at Coatbridge. The registered offices of the Scottish Company have been removed to 49, Queen Victoria Street, E.C.

Gas and Gas Engines.—An *Echo* correspondent complains of the high gas charges in London. He mentions the great increase in the number of gas engines, and considers that as these are the means of an enormous additional consumption of gas, a reduced charge per 1,000 should be made, similar to that of the electric light companies, who have a reduced unit charge for current used for cooking and motive power purposes. The electric light companies, however, make the reductions for the purpose of increasing the day load.

First Niagara Dynamo.—An American exchange says that the first 5,000 horse-power dynamo made by the Westinghouse Electric and Manufacturing Company for the Cataract Construction Company, arrived in Niagara Falls on January 11th. The three turbines, of 5,000 horse-power capacity, made by the I. P. Morris Company, of Philadelphia, are all in position. The dynamo will be immediately set up and attached to one of these. Before the dynamo was sent from the Westinghouse Works, it was set up and tested.

Fire at Kensington Court Central Station.—We regret to record that a fire broke out late on Tuesday night on the premises of the Kensington and Knightsbridge Electric Lighting Company at Kensington Court, almost destroying the three storeys of their large buildings. Foreman Holland, with his wife and three children, were asleep in rooms at the top of the building at the time. The youngest of the three children was suffocated. The boilers, engines, and other plant were saved, and under the management of the engineer-in-chief, Mr. Crompton, the supply of current was maintained throughout the night. A *Star* man who has been over the ruins finds the plant preserved and working, the fireproof floor of the battery room having resisted the flames effectually.

A Record.—The Acme and Immisch Electric Works, Limited, have received the following communication from the Greenside Mining Company, Limited, of Greenside, Patterdale, Westmoreland:—"It affords us great pleasure to inform you, and we have no doubt you will be pleased to hear, that our electric locomotive has just completed her 'six thousand' (6,000) miles of running with her average working load of 20 tons at a cost of only £12, and this for renewing the training wheels which have just been replaced. The wearing of these can be, to a great extent, accounted for, seeing that some of the gradients are equal to 1 in 20, necessitating a heavy brake being applied occasionally. The electrical part of the locomotive has required no repairs whatever, the armature and commutator apparently are as good as at the first; the latter has never been turned up since it left your works. Taking into consideration the exceedingly sharp curves and their frequency in the line of rails, to say the least, the wear and tear is really surprisingly low, and does great credit to the workmanship on the machine; in fact, the whole of the extensive electrical plant you have supplied us is in splendid working order, doing good duty, and has from its erection, now three years, proved thorough efficiency at an infinitesimal working and repairing cost. We look upon the work accomplished by the locomotive as marvellous, it having far exceeded our expectations in ability and cost of maintenance. —Yours faithfully, *pro* The Greenside Mining Company, Limited. W. H. Borlase, *Manager*."

We illustrated this locomotive in our issue for October 12th, 1894.

The Telephone Service.—At a large meeting of Scotch members at the House of Commons, on Wednesday, resolutions were passed condemning any private monopoly of the telephone service, and urging on the Postmaster-General the importance of granting municipal corporations or local authorities licenses to establish telephone exchanges.

Subsoil Rights.—An action heard last week in the Chancery Division of the Law Courts, raised a question of first importance to underground railway men. One, Farmer, in July, 1894, received intimation from the Waterloo and City Railway Company that the company required to appropriate and use the subsoil under his property, and construct, at a considerable depth below his cellars, tunnels in which to run their railway. The company accordingly commenced boring operations recently under the property, and in consequence the plaintiff instituted proceedings against them for the purpose of obtaining an interim injunction to restrain the defendants from entering upon or under his premises or property. Mr. Justice Kekewich having heard the arguments of council, which were chiefly on legal points, delivered his opinion, which was to the effect that upon the whole the plaintiff was entitled to an injunction. As the parties consented to the hearing of the motion being treated as the trial of the action, Mr. Justice Kekewich made a declaration that the defendants were not entitled to appropriate and use the subsoil under plaintiff's property until the provisions of the 1845 Act had been complied with. The defendant company were ordered to pay the costs of the action. We presume it now remains for the constructors of the line to deviate from the course originally decided upon—and this we believe is hardly possible—or enrich Mr. Farmer to whatever extent he chooses to demand. Electric or other railways can hardly be expected to go ahead in the metropolis while the law places such hindrances in the way.

NEW COMPANY REGISTERED.

The New Mayne Electric Rudder Motor Syndicate, Limited (43,150).—This company was registered on January 29th with a capital of £20,000, in £10 shares, to acquire the English patents of Messrs. New & Mayne's invention for an electric rudder-motor, which is covered in Great Britain by letters patent dated 8,316, of 1893, 15,921, of 1894, and 22,134, of 1894. The subscribers (with one share each) are: J. L. Higgs, Walton-on-Thames, gentleman; J. B. Gilbert, Hampton, Ealing, clerk; J. B. Hutchins, Sydenham, gentleman; W. H. Williams, Osbaldston Road, N.; H. P. Herbert, St. Germain's Road, S.E., clerk; P. Wolfenden, Hornsey, solicitor; G. J. Fleming, Leyton, clerk. Registered without articles of association by W. H. Smith & Son, Gresham House.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Carbon Syndicate, Limited (41,991).—The registered office of this undertaking is now situate at 8, Furnival's Inn, London, E.C.

Capsule Battery Company, Limited (42,039).—The registered office of this company is situate at 32, Great St. Helen's, London, E.C.

CITY NOTES.

City of Bath Electric Lighting and Engineering Co., Limited.

ALTHOUGH it is not yet considered advisable to give the ordinary shareholders a dividend, the company is to be congratulated on the position to which it has attained. The work for the past 18 months has been carried on with commendable economy, and instead of the melancholy state of things which existed two or three years ago, we may deduce the most hopeful prospects from the present balance-sheet. It was only in the latter part of 1893 that an economical *régime* was established, and the loss of £306 in 1892 was replaced by a profit of £188 in 1893. The profit of £702, which is the result of last year's working, speaks volumes for Mr. Metzger, the managing engineer.

The directors have thought it right to clear from the books all long outstanding debts, and believe that ample provision has been made for every possible contingency. A small dividend was possible this year, but we think the directors are wise in carrying the balance (£563) forward. The sum of £2,313 has been spent on additions during 1894, and we note with interest that part of this has been applied to adapting some of the furnaces to burn oil fuel. The lamp connections have appreciably increased during the past few months. During the late disastrous floods Bath suffered acutely, and for four days the only artificial light was that supplied by this company. This should stand them good service, even in the eyes of the Town Council.

The following is the analysis of the cost of a Board of Trade unit:—

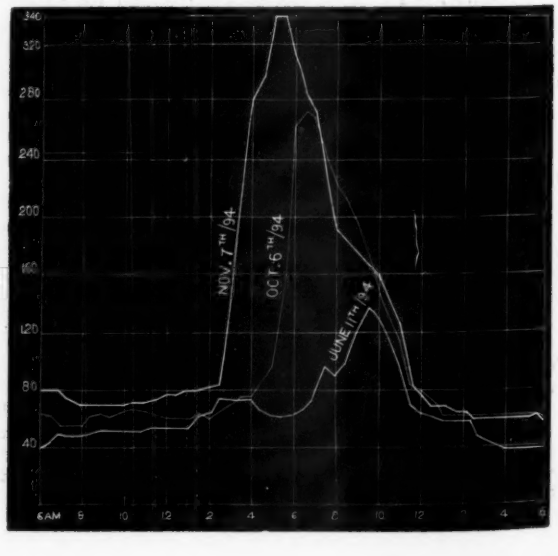
	1894.
Total capital invested	£41,087
Number of units sold	209,077
Number of lamps connected	8,327 8-C.P. 84 1,200 C.P. arcs.
Revenue from sale of current	£4,594
Net revenue	—
Average price obtained per unit...	5·2d.

Cost of production.	£		Per unit.
Coal	1,245		1·43d.
Oil, waste, carbons and engine room stores	445		·51d.
Salaries and wages at generating station	1,058		1·21d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	274	Works cost 3·46d.	·31d.
Rates and taxes	155		·17d.
Management expenses, salaries of managing engineer, secretary, clerks, stationery and printing, auditors, law charges, insurance, bank charges, mortgage, and debenture interest	855		·98d.
Depreciation of buildings and plant account	—		—
Renewal fund account	—		—
Total	£4,032		4·61d.

Revenue.		Average price obtained per unit.
By sale of current	£4,594 0 0	—
Meter and Transformer Rents ..	76 0 0	5·2d.
Sale of lamps and sundries	396 0 0	
Total	£5,066 0 0	5·2d.

The Newcastle and District Electric Lighting Co., Limited.

MR. JAMES PATTERSON, the secretary, has been good enough to send us three typical load curves, showing the output of the station on three different days of year. The November curve is a good one, but the summer load is rather a melancholy one. Still, the company thrives.



The 1894 dividends.

The following are the dividends which have been declared up to the present by electrical and allied companies for 1894. Alongside will be found the dividend for the previous year:—

Electricity Supply Companies.	1894. Per cent.	1893. Per cent.
St James's Electric Lighting Company ...	6½ ord. shares	4½
Westminster Electric Light Corporation...	5 „	4
Yorkshire House-to-House Electricity Co.	4 „	...
City of London Electric Lighting Co. ...	5 „	...
Newcastle and District Electric Lighting Company	6 „	5½
Liverpool Electric Supply Co., Limited...	6 „	5
Charing Cross and Strand	4½ „	4½
Kensington and Knightsbridge	5 „	...
Manufacturing.		
Telegraph Construction and Maintenance Company, Limited	20 „	20
India-Rubber and Gutta-Percha Company	10 „	12½
Telephone.		
National Telephone...	5 „	5
Traction.		
Liverpool Overhead Railway	2 „	1
Douglas and Laxey Electric Tramway ...	7½ „	...
City and South London Railway	1¼ „	⅝

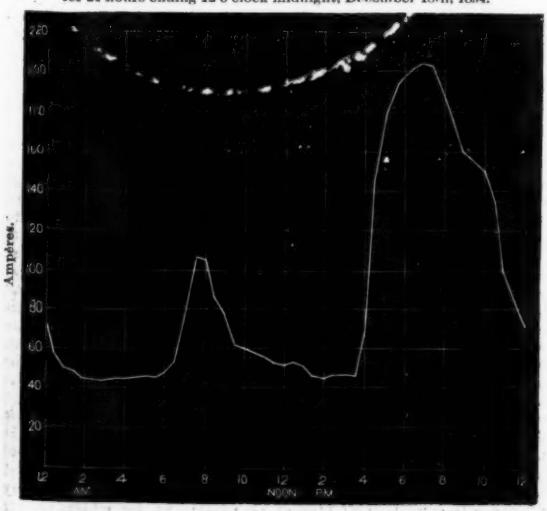
The House-to-House Company.

We now deal with the balance-sheet of the House-to-House Company, which was unavoidably crowded out of our last issue. Before giving this, however, we give the following table extracted from the directors' report, which shows how well the company has progressed.

Year.	Equivalent of 35-watt lamps connected.	Increase in 35-watt lamps.	No. of houses connected.	Gross revenue.	Expenditure.	Net revenue.
				£ s. d.	£ s. d.	£ s. d.
1890	13,665	9,145	248	5,010 9 2	4,624 6 5	386 2 9
1891	19,388	5,723	373	8,328 3 11	6,077 1 10	2,250 9 1
1892	23,700	4,312	471	10,688 18 6	7,851 19 6	2,836 19 0
1893	28,429	4,729	599	12,063 10 10	7,832 6 8	4,231 4 2
1894	35,858	7,429	755	13,695 11 8	7,431 16 8	6,263 15 0

The directors regret that the £16,000 of ordinary capital appropriated to construction business development (leased to the Leeds and London Electrical Engineering Company, Limited) is not productive of any profit this year. No doubt this sum may produce something in the future, but it is a great pity that ordinary capital of a supply company should ever have been devoted to construction

A typical load curve of the House-to-House Company (2,000 v. alternating) for 24 hours ending 12 o'clock midnight, December 18th, 1894.



business. To our minds it is distinctly bad policy for supply companies to undertake construction work of any description, or to invest money in manufacturing concerns. This is, of course, the result of an old line of policy of the House-to-House Company, and is on a level with the £25,000 7 per cent. cumulative preference shares with which the company is sadly hampered. Still, we have nothing but congratulations to offer the company on the present balance-sheet.

After deducting £1,898 11s. 10d. for interest paid on £30,000 debentures and on temporary loans, the balance is being dealt with as follows:—

In reduction of preliminary expenses	£500
In extinction of suspense renewals account	200
Depreciation account	1,450
Dividend of 7 per cent. on £25,000 cum. pref. shares	1,750
In reduction of construction business development account	400
Balance carried forward to next account	108
	£4,408

	1892.	1893.	1894.
Total capital invested	—	£77,177	£83,847
Number of units sold	—	358,506	400,911
Number of lamps connected ...	23,700	28,429	35,858
Revenue from sale of current ...	£10,688	£11,126	£12,578
Average price obtained per unit..	—	—	7·44d.

Cost of production.	£		Per unit.
Coal	2,863		1·71d.
Oil, waste, water and engine room stores	665		·38d.
Salaries and wages at generating station	1,706		1·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	364		·21d.
Rates and taxes	386	Works cost 3·32d.	·23d.
Management expenses, director's remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,311		·78d.
Depreciation of buildings and plant account	2,530		1·52d.
Renewal fund account	nil		—
Total	£9,545		5·85d.

Revenue.		Average price obtained per unit.
By sale of current	12,578 17 8	—
Meter rents	1,016 9 2	7·44d.
Other receipts	100 4 10	—
Total	£13,695 11 8	7·44d.

Total cost per unit (exclusive of depreciation and renewal accounts), 4·33d.; works cost, 3·32d.

Leeds Electric Supply.

We are glad to note a still further reduction in price of current supplied by the Yorkshire House-to-House Electricity Company, Limited. Commencing on the 1st July next, the price per Board of Trade unit will be as follows:—

When the consumption for the quarter does not exceed 1,500 units ... ... 6d.
When the consumption for the quarter exceeds 1,500, and does not exceed 3,000 units ... ... 5½d.
When the consumption for the quarter exceeds 3,000 units 5¼d.

These prices will be subject to discount based upon the number of hours per quarter during which the current is used, each consumer being called upon to declare the maximum number of lights required to be in use at any one time.

The scale of discounts is as follows:—

For not less than 300 hours' use (in the quarter) of the maximum supply demanded ... ... 5 per cent.
For not less than 450 hours' use (in the quarter) of the maximum supply demanded.... ... ... 10 per cent.
For not less than 600 hours' use (in the quarter) of the maximum supply demanded ... ... 15 per cent.

In addition to the discounts accruing under the above table, a discount of 5 per cent. will be allowed on the net amount of accounts paid within one month from the date of rendering, and 2½ per cent. on accounts paid within two months.

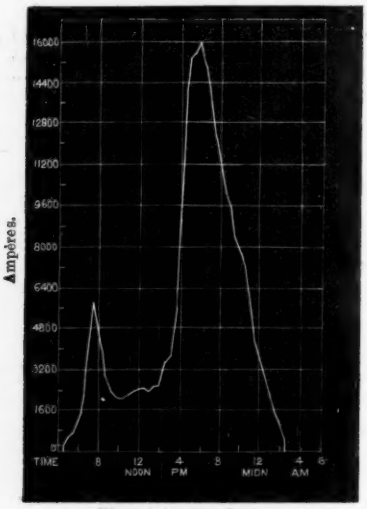
For heating, cooking, and power purposes, current will be supplied at 3d. per Board of Trade unit, less discount for cash (5 per cent. or 2½ per cent.) as above.

The Westminster Electric Supply Company.

There can be but few complaints of the report and accounts just issued. The business of the company continues to grow at a satisfactory rate. The supply of current, which on December 31st, 1893, was provided for the equivalent of 131,565 lamps of 8 C.P., had at the end of last year increased to 175,695, and applications had been received for a further 8,817. The net revenue of the year amounts to £16,168 18s.; out of this an interim dividend at the rate of 4 per cent. per annum for the

half-year ending June 30th, 1894, has been distributed. The board are now recommending the payment of a dividend at the rate of 6 per cent. per annum, which makes 5 per cent. for the year.

Load diagram on third Thursday in December, 1894.



Westminster Supply curve.

A paragraph in the report speaks of the increase of capital of the company. We have already recorded the fact that it had been resolved to increase the capital from £300,000 to £400,000, by the creation of 20,000 £5 shares. Of this amount, £40,000 has been issued. It will be seen from appended analysis that considerable sums are being placed to depreciation, and to sinking fund accounts. The cost per unit shows a considerable reduction on the 1893 figures:—

	1892.	1893.	1894.
Total capital expended ...	—	£381,276	£411,018
Number of units sold	1,217,871	1,704,615	2,173,298
Number of lamps connected ...	98,686	131,565	167,703
Revenue from sale of current...	£34,954	£41,949	£50,168
Average price obtained per unit	6·88d.	5·9d.	5·5d.

Cost of Production.	£		Per unit.
Coal	5,841		·64d.
Oil, waste, water, and engine room stores	1,227		·13d.
Salaries and wages at generating station	6,865		·75d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,495		·16d.
Rates and taxes	2,861	(Works cost 1·69d.)	·31d.
Management expenses, directors' remuneration, salaries of managing engineers, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	6,452		·71d.
Depreciation of buildings and plant account .. .. Sinking fund account	5,000		·55d.
Total	£29,744		3·28d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	50,168	9	9	—
Meter rents	2,477	15	4	—
Transfer fees	46	5	0	—
Total	£52,691	10	1	

Total cost per unit (exclusive of depreciation and renewal accounts), 2·71d.; works cost, 1·69d.

We give above a typical winter's day load curve.

The Kensington and Knightsbridge Electric Lighting Company.

Simultaneously with the receipt of this company's report and accounts is a telegram from Mr. Crompton that the Kensington Court Station has been burned out, and that one life has been lost. We understand however that the boilers and engines were not destroyed, and that electric supply was maintained.

The accounts cover a period when a great reduction in the price per unit was made, the price of 8d. being reduced to 6d. last July.

There has been a large increase in the number of consumers, the number of houses and shops connected with the system having increased from 734 on 31st December, 1893, to 908 on the 31st December, 1894, while the number of 8-C.P. lamps has increased from 64,529 to 80,678.

The directors have thought it advisable, in view of the increased profits of the company to use a large portion of that increase in writing off the balances of the preliminary expenses and cost of debenture issue account (£500), and of the suspense account (Law, £1,119). They have also thought it advisable to strengthen the renewal account by transferring to that account £3,457.

After providing for the above amounts and paying the dividends on the 6 per cent. preference shares to June 30th, 1894, on the 5 per cent. second preference shares to September 30th, 1894, and an interim dividend at the rate of 5 per cent. on the ordinary shares for the first half of the year, the balance standing to the credit of the nett revenue account is £4,235; of this £1,450 has been appropriated to the payment of the first preference dividend to the end of the year, and £150 has been set aside to meet the portion of the dividend on the second preference shares accrued to the same date, leaving £2,635, out of which it is proposed to pay a further dividend on the ordinary shares at the rate of 5 per cent. per annum for the past half-year.

We shall analyse the cost per unit next week.

The Charing Cross and Strand Electricity Supply Company.

The report of this company is a record of steady progress. The corporation on December 31st was supplying energy to 41,216 8-C.P. lamps, an increase of 19·7 per cent. on the number supplied at the end of 1893. The directors have written £485 off preliminary expenses and carried £1,600 to depreciation account. Provision for bad debts has been made by a deduction of £150 from the amount of sales of current, in the manner required by the Board of Trade. The net earnings have amounted to £10,395; £3,117 has been paid in respect of interest on debentures up to December 31st, 1894, and £2,906 was distributed in payment of an interim dividend for the half-year ended June 30th, 1894. A sum of £3,929 which remains, is to be dealt with in the following manner: A dividend of 4½ per cent. for the year, absorbing £3,625, and the remaining £304 to be carried forward.

We shall in all probability deal with the accounts more fully in our next issue.

The St. James's and Pall Mall Electric Light Company.

The annual meeting of this company was held at the offices of the company, Carnaby Street, Golden Square, last Tuesday, Mr. Gerald Balfour, M.P., presiding.

After the Secretary had read the notice convening the meeting,

The Chairman said he thought the company might congratulate itself generally upon the result of the year's working. They were going to pay a dividend of 6½ per cent. upon the ordinary shares instead of 4½, the preference remained at 7. He confessed that he would have liked to have had a little margin to pay something to the holders of the founders' shares, but this year it was not to be. Possibly, if things went well with them another year, they might be able to arrive at that result. The question of the increase of plant would have to be met, because very soon they would not be able to work safely. This was due to the fact that Mason's Yard station could not be trusted to do its full share of the load. As they were probably aware, an action had been brought against them by the Vestry for nuisance, but while that action was pending his tongue was tied. But in any case they had come to the conclusion, on the advice of their engineers and other experts, that the 1,600 H.P. which Mason's Yard was calculated to give could not be fully relied on, and they proposed to increase the capacity of Carnaby Street station, and deal with Mason's Yard as advised. For that purpose they would have to raise some more debentures, under the powers already possessed. He was not, however, in a position to say more, because figures had not been fully gone into. During the past year the cost of working had been still further reduced to the extent of ½d. per unit. He need not say that this result did infinite credit to the engineering staff. They would find in the accounts an increase under item of rates. They had done their best to get the assessment reduced, but, unfortunately, they had no right of appeal, and the matter would now have to stand over until the next quinquennial valuation took place. There was one possible difficulty ahead which they were doing their best to guard against: the rivalry of the London Electric Supply Corporation. They had power, and they might exercise it, of reducing rates to such an extent that the business would cease to be remunerative. Such a course would be as much against them as it would against the St. James's. They were using every endeavour to come to some kind of an agreement, by which neither company could cut its throat. They would remember that he mentioned the subject last year, and he then stated that the then chairman of the London Company was incorrect when he remarked that this war of rates had been commenced by the St. James's Company. They had always been, in the interests of their shareholders, anxious to work in a friendly manner with their rivals, and he had real cause for hope that this friendly spirit would continue between them. After referring to the loss of one of the directors, Mr. Woodburn Kirby, the chairman, in thanking the staff, said that their company

might be regarded as the model company for all others in the economy of its working, and in its freedom from accidents. This year had begun in a most satisfactory way; during the first five weeks of the quarter there had been an increase in gross revenue of no less than £1,500. They had also increased their customers since December 31st by 26, and in the same period the lamps had advanced from 75,217 to 76,610. He then formally moved the adoption of the report.

Mr. Latimer Clark seconded.

In answer to questions, the Chairman said that it was not until 7 per cent. had been paid on the ordinary shares that the founders' shares were entitled to a dividend. The debenture stock would not be issued before they wanted money. All questions of danger to the public received the careful attention of the board, and every incident that occurred which had the slightest suspicion of danger was reported. They had had only one very slight accident, which was a small explosion of gas at the bottom of St. James's Street, by which no one was injured. Both their engineer and the adviser of the Board of Trade were engaged in providing a remedy against the recurrence of such accidents. The Southwark Bridge accident, though nothing to do with their company, was not caused by electricity. Their system was low tension, and could not, except in very special circumstances, cause an explosion, and it could not cause danger to life through shock.

The report and accounts were then adopted.

A special vote of thanks to the chairman, directors, and staff, concluded the business of the meeting.

The National Telephone Company.

Mr. J. Staats Forbes presided at the meeting of this company held yesterday at Cannon Street Hotel. He referred to the fact that that was the first of the six months' meetings which had been inaugurated. There was an increase in respect to the business; there was also an increase in the royalties to be paid to the Post Office, it being increased from £31,000 to £34,000. There had been an increase in the net revenue, but the working expenses were rather more than the whole of the increase in revenue. This was due, however, to the fact that a special provision of £15,000 had been made for the effects of the severe storms which they had sustained during December and January. They had thought it prudent to debit the working accounts with this sum, so that they could place themselves in the position they were before the storms played such havoc with their property. The net result was therefore £138,000, against £142,000, but the corresponding half-year was not loaded with a sum of £15,000. That sum deducted from the expenses and added to the net result would have put another complexion upon the matter. The stores and materials had been written down considerably. Passing on to speak of the reserve, the chairman said it was very necessary to have a large one with a company of this description. Nobody knew what might happen to the company, though personally he did not think much would happen. The chairman, after going through the accounts in detail, spoke of the relations with the Post Office. They had signed an agreement with the Post Office, and in a memorandum the company had undertaken not to construct any further trunk lines, in spite of the inconvenience which the telephonic public would suffer. The longer the agreement, however, remained inoperative, the more severe did the delay affect them. After referring to the proposed new issue of debentures, he proposed the adoption of the report and accounts.

Lord Balfour of Burleigh seconded.

After some remarks from the shareholders on the necessity of having a liquid reserve, the Chairman said that they thought they would receive from the Post Office for trunk lines £400,000, and it was quite likely that this, or the greater portion, would form part of a reserve.

The meeting then concluded.

Cuba Submarine Telegraph Company.

The report of the directors for the half-year ending December 31st, 1894, presented at the forty-seventh ordinary general meeting on February 13th, states that the gross receipts amount to £20,769 15s., and the gross expenditure to £5,633 10s. 2d., leaving a sum of £15,136 4s. 10d., which, added to the balance brought from the last account, £3,429 5s. 11d., leaves £18,565 10s. 9d. at the credit of revenue account. Of this the sum of £1,000 has been set aside as a further reserve against any loss from the deposits with banks, and £4,785 7s. 3d. added to the reserve fund, which now stands at £100,000. The dividend on the preference shares will absorb £3,000, and leave £9,780 3s. 6d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, free of income tax, the balance, £3,380 3s. 6d., being carried forward to the next account. The cables have continued in good order throughout the half-year. The new cable between Batabano and Cienfuegos is now being laid, and the directors are in daily expectation of a telegram announcing the completion of the work. The instalments already paid have been deducted from the reserve fund, which will also be charged with the balance of the contract price. The position of the company's suit against the Spanish Government at Madrid remains the same as at the date of the last report.

Mr. Thomas Greenwood, who presided at the ordinary general meeting of this company on Wednesday last, said the present balance sheet showed no exception to the generally favourable ones presented. Traffic receipts showed little variation, interest on investments were rather less than at the corresponding period, but that was due to an excess of interest in the former accounts. It was the interest on some money deposited at the bankers having been delayed and coming together in one lump, with that exception the receipts might be taken to be more favourable than they were twelve months ago. The expenses at the stations were about £300 more than they were in the corresponding period. They had made provision in that half-year's accounts for putting an aerial cable in the place of some of the wires, which had cost £600, but they had improved the state of the line to that extent. There was an increase in the income tax due to the fact that the commissioners would not allow, as heretofore, a reduction in respect to hire purchase cable. The reserve fund now stood at £100,000, it was £105,000 twelve months ago, but they had paid some £17,000 on account of the purchase of the new cable. He was pleased to say that they had just received intelligence from the other side, that the cable had been successfully laid. Speaking of investments the chairman said he expected they would lose pretty considerably over the New English Bank of the River Plate. They had, however, £6,500 to meet any charge, including any deficiency that might arise from the Australian Banks.

After a little discussion the report was adopted.

County of London and Brush Provincial Electric Lighting Company, Limited.

A first issue of 10,000 6 per cent. cumulative preference shares of £10 each at par, and a further issue of 10,000 ordinary shares of £10 each at 5s. per share premium are offered for subscription by the Electric and General Investment Company, Limited, on behalf of the County of London Company. The Preference Shares are payable as follows—£1 on application, £1 on allotment, £2 on June 29th, 1895, £2 on September 30th, 1895, £2 on December 31st, 1895, and £2 on March 31st, 1896. The payments on the ordinary shares are to be £1 on application, £3 5s. on allotment (including premium of 5s.), and £6 on March 30th, 1895. Holders of shares of the company are to be considered preferentially. Future issues of preference shares will be made only at a premium.

India-Rubber, Gutta-Percha, and Telegraph Works Company.

At the meeting held yesterday, Mr. S. W. Silver (the Chairman) said, after the hard struggles they had gone through, they were disappointed with the year's results. They had, along with other industrial concerns, suffered from the universal depression, and, added to this, competition had seriously affected their profits. The unprecedented state of the market had much to account for. In the absence of submarine work their steamers had been idle; the reserve had proved a valuable auxiliary fund, and had enabled them to purchase raw material in large quantities at low prices, which they could lay by for future requirements. There are now indications of a revival in the commercial world, but they would have to exercise great caution in effecting sales, as a new system of transacting business is gaining ground, of a character more likely to result in loss than profit. They had tendered for the 8,000 miles of cable for the Pacific. One of their directors, the Hon. W. Marsham, and Mr. M. Hamilton Gray, their chief engineer, had followed that matter well. The *Dacia* had completed the contract for the repair of a cable for the Spanish Government. Altogether, they thought the next report would be more favourable.

Mr. Henderson seconded the resolution, and after a few questions had been asked, it was carried unanimously.

Liverpool Electric Supply Company.

The twelfth ordinary general meeting of the Liverpool Electric Supply Company was held on Friday, 8th inst., at the Exchange Station Buildings, Tithebarn Street. Mr. Arthur Hill Holme, chairman of the company, presided, and there was a large attendance of shareholders. The directors, in their report, stated that the total number of lamps connected to the company's supply mains on January 1st, 1894, was 25,784, and on December 31st the number had risen to 31,792. The amount to the credit of profit and loss account, including the balance brought forward from last year, was £15,601 7s. 4d. Out of this sum an interim dividend at the rate of 5 per cent. per annum was paid for the half-year ending June 30th, and the directors recommended the payment of a further dividend at the rate of 6 per cent. per annum for the half-year ending December 31st. It was also recommended that £1,359 5s. be added to the reserve fund, carrying forward £1,136 8s. 10d. to next year's account. The expenditure on capital account during the year, including a proportionate charge for general expenses, had been £40,786. Considerable additions had been made to the plant at the Highfield Street and Oldham Place stations, and the mains had been extended where necessary to meet the demand. It was anticipated that in the future the residential districts served from the company's Lark Lane station would form a very valuable section of the company's supply area, without requiring any large capital expenditure. The report then referred to the negotiations that had been instituted between the company and the corporation for the immediate purchase of the undertaking

under the powers of the Liverpool Electric Lighting Order of 1891. As the corporation had the right to acquire the company's business in 1900, the directors did not wish to adopt any obstructive policy, due regard being paid to the interests of the shareholders. Should the corporation offer terms which appeared to the directors to be acceptable, the matter would be laid before the shareholders for their approval.

The CHAIRMAN, in moving the adoption of the report, said the company had had a very good year, and they might congratulate themselves upon the increased business they had done. They had increased their lights by something like 6,000 over January, 1894. This was very gratifying, and showed an increase of 25 per cent. It was also gratifying to think that the increase was a steady one, for they had increased at the rate of 25 per cent. each year for the past three years. That the public had taken a great interest in the electric light was apparent from the large number of customers the company could boast of. On December 1st, 1889, the total number of lights supplied by the company was 2,907, whereas it was now 31,792, indicating that there was a great demand for the light, and that they were supplying a great public necessity. Whilst recognising the interests of the shareholders, they had not forgotten the customers. When the company commenced business, they charged a rate of 1s. per unit, which was afterwards reduced to 8d., and later on to 7½d. He had not the slightest doubt that if they extended the lights in the same ratio as at present, they would be able to make further concessions. He was sure that if they had about double the number of their present lights, they would be able to reduce their charge to something like 5d.; but this was a matter that must be considered by the consumers. The £40,000 expended on the capital account last year had been spent on work at the Highfield Street station, where they had put down three more boilers and large engines. They had also devoted considerable attention to the machinery at Oldham Place station. The company had also bought land at both those places, and would therefore have facilities for any extension that might be necessary within the next three years. With reference to the Lark Lane station alluded to in the report, he said it was one of the cases in which the company had a large amount of undeveloped power, and anyone buying their undertaking would find that there were a great number of engines and mains and appliances for supplying the electric light which had not at present come into use. If trade were better, there were many people in the neighbourhood who would use the electric light. Referring to correspondence which had appeared in the newspapers on the subject of electric lighting, he remarked that one writer said the only system to be adopted with profit was the high tension system; but he (the chairman) was quite content to trust their engineers. As electric science went on, they might adopt some modification of such a system, but at present they found it better to have the low tension, and they had no explosions, no singeing of people, or accidents in the streets. Speaking of the negotiations between the company and the corporation, he asked the shareholders to leave the matter in the hands of the directors, and say nothing that would give anyone a "handle." While some of the shareholders would probably think that the undertaking should be sold, others might think that it should not; but he asked the shareholders to trust the directors not to sacrifice the property, and yet not to ask too high a price so as to make negotiations impossible. So far as the corporation was concerned, the company had nothing to fear from them, and very little to hope for. The corporation had never helped them, and everything that they had done had been done in spite of the corporation. For any work the corporation had done for them—and they were compelled to let them do certain work—they had always charged a most enormous price. When they had reinstated pavements for them, the corporation had charged them three times as much as was charged for such work in Birmingham. The corporation had now £700 of their money, for which they did not get any interest. Some of their customers grumbled at the meter rent, but the company had to pay 7s. 6d. for each meter tested. In concluding, he said the company was commenced under difficult circumstances; it had been developed with determination, and even if that should prove to be the final general meeting of shareholders, owing to the company being about to die, he thought it would deserve well of their fellow-townsmen.

Sir DAVID RADCLIFFE seconded the motion.

The CHAIRMAN, replying to a question asked by Mr. Crosthwaite as to any possible competition on the part of the corporation, said the corporation had abandoned their scheme for the present. Of course they could get powers to compete with the company in the supply of the electric light, but if the lighting was done well, the Board of Trade would not give such powers to the corporation.

The motion was then carried.

On the motion of the CHAIRMAN, seconded by Mr. VON SOBBE, the recommendation of the directors for the payment of a dividend at the rate of 6 per cent. per annum for the past half-year, was carried.

Messrs. Th. Von Sobbe and D. de Ybarrondo were re-elected directors, and it was resolved that 750 guineas be placed at the disposal of the directors as remuneration for their services during the year.

Mr. W. L. Jackson having been re-elected auditor, and a vote of thanks passed to the chairman and directors for the attention they had given to the business during the past year, the proceedings terminated.

The House-to-House Electric Light Supply Company, Limited.

THE annual general meeting of this company was held at the offices of the company, Richmond Road, S.W., on Friday last.

Mr. H. R. BEETON (the Chairman) formally moved that the sixth annual report for the year ending 1894 be received and adopted. He then said: Shareholders who have read the report will notice that the business continues to show a steady growth. During the last year the number of lamps connected shows a larger increase than in any year of the past three, and the gross revenue, which shows an increase of £1,452, has been obtained at a reduced expenditure of upwards of £400. The reduction in expenses is very general throughout most items in the revenue account, and testifies to the economical organisation and the effective supervision of the station. The capital account of the company shows an expenditure of £6,670, as compared with £7,409 during the previous year. The larger portion amounting to £3,000 has been expended on mains, which, whilst covering the company's area, is, for the time being, more or less unproductive expenditure. In view of the results which we now present to the shareholders, the directors have it under consideration whether it may not be desirable in the general interests of the undertaking to make an early substantial reduction in the price of current to consumers. The board is not in a position to make at this moment any definite statement in that regard, but when they do so they hope it will not prejudice the net revenue of the company, although it will undoubtedly affect its rate of progress. There is one item in the accounts upon which it may be desirable to comment, that is the return in respect of the company's expenditure on construction business, which is represented in the balance-sheet of the company by an asset of £16,700. Since the issue of the report to the shareholders, the directors have not received the accounts of which they hoped to be in possession. They are very disappointed that the admittedly large business which has been transacted under the agreement is not productive of profit to the company, and they will make it their business to investigate the circumstances under which such a result has been obtained, with a view to protecting the interests of the company as far as they may be able to. I ought to say that the board feel that the satisfactory results which they are enabled to present to the shareholders are in a large measure due to the admirable services which have been rendered by Mr. Page as managing director, and Mr. Bowden as manager of the works. In concluding, I would mention that in future the dividends on the preference shares will be paid half-yearly. With those observations, I propose that the report and accounts be received and adopted.

Mr. W. F. LEESE seconded.

Mr. WILLIAM PAGE, managing director, in supporting the resolution, said they had, practically, eight interests to consider: there were the employés, there were four classes of stockholders, the public, and the auditors; and, last of all, the directors. All the interests of these had to be looked after and balanced as nicely as possible. It would be seen from the report that the directors had been very liberal, for out of the £1,500 they were entitled to take per annum, they had only taken £300, which, with the £200 to himself, made £500 for the year, while until last year they took none at all. In the best interests of the ordinary shareholders they had to look after the public, and it was in the best interests of the shareholders that a reduction in the price of current should come as soon as possible. Before that could be done, they must make provision for it in the way of plant, because he anticipated a reduction in price would mean an increased demand. To meet that demand was the principal thing operating in the minds of the directors against a very early reduction. Plant of the best type could not be got very readily; they had plant on order, and after the extension of the works they would be able to meet a larger demand. The results referred to by the chairman in the way of reduced expenditure had been principally brought about by great economy, for which Mr. Bowden had been very largely responsible, and they owed him a great deal for the indefatigable way in which he had worked to bring about this result. The Leeds and London business was under the control of the celebrated firm of John Fowler & Sons, of Leeds, and with their reputation for good work and business ability, he did not think that when the company got into working order it would be allowed to be unsuccessful.

The report was then adopted.

The retiring directors and auditors were then re-elected, and the meeting terminated.

Liverpool Overhead Railway Company.

THE thirteenth ordinary half-yearly general meeting of the Liverpool Overhead Railway Company was held on Tuesday at the Law Association Rooms, Cook Street, Liverpool, Sir William Forwood, chairman of the company, presiding.

The report of the directors referred to the increase in traffic, as shown by the number of passengers carried, as being very gratifying. The increased working expenses were mainly due to the additional train mileage of 70,933 miles due to the opening of the northern extension, and the cost of working the three new stations, at the Nelson and Langton Docks and Seaforth Sands. The traffic on the northern extension had fully answered expectations, and the experience which the directors had thus obtained had determined them to ask the shareholders to approve of the construction of the southern extension, for which the company hold Parliamentary powers.

The CHAIRMAN, in moving the adoption of the report and accounts, said he felt certain they would be satisfying to the shareholders. They were enabled to pay a dividend of 2 per cent. on the ordinary shares, which was double the dividend they were able to pay last year. They were also able to carry an increased sum to the fund for the maintenance of the permanent way. The gross revenue for the half-year had been £25,700, and the profit, after deducting the working expenses, amounted to £8,538. In addition to the dividend on the ordinary shares, they also recommended 5 per cent. on the preference shares, carrying a balance of £1,087 to next half-year. In order that they might appreciate the position of the company, and

form some opinion as to their prospects in the future, he proposed to give a few comparative figures relating to the past half-year and the corresponding half-year of the preceding year, and it would be well to bear in mind that in the meantime they had opened the northern extension to Seaforth, and also three new stations. The former had given them increased earnings, and in connection with the latter there had been increased expenditure. The train mileage run during the past half-year was 314,472 miles, as compared with 243,539 in the same six months of 1893, being an increase of 70,933. The passengers carried numbered 3,641,379, as against 2,475,669, an increase of 1,166,000. When they originally issued the prospectus of the company, the directors were bold enough to say that they expected the traffic from the line would be 6,000,000 passengers per annum. A great many people thought, in making that estimate, they were very sanguine people. He was glad to be able to report that at the end of the year they were carrying at the rate of 7,250,000 passengers per annum, and he did not think they had yet reached their limit, because the more facilities they gave to the people, the greater the traffic would be. He did not think the public of Liverpool had, as yet, realised the advantages and facilities offered by the railway, which was not as much used by the merchants and shipowners and brokers of the port as it was capable of. The gross revenue for the half-year showed an increase of £7,300 over the corresponding half of the preceding year. The average receipts per passenger amounted to 1·61d., but during the past two months, since they had made some readjustments in the return fares, the average receipts had increased to 1·91d. On the other hand, their working expenses for the half-year had been £17,162, against £13,732 in the six months of 1893, an increase of £3,430. Looking at the figures in detail, however, they would see that the increased expenditure was quite justified, having been incurred in connection with the new stations, and in making further provision for the maintenance of the permanent way. The locomotive expenses were £4,253, as against £4,089, the increase being caused by the greater number of miles run; but it would have been much larger had they continued the contract with the Electric Construction Corporation which existed last year. Had that been in vogue, they would have spent £1,200 more for locomotive expenses than they had done for the last half-year, therefore he thought the directors were justified in terminating the contract, and taking the working upon their own shoulders. If they compared the expenses of their line with the only other electrical railway in the kingdom, the City and South London line, they would find that the working expenses on the Overhead Railway per train mile during the half-year were 13·10 pence, as against 15·36 pence on the London line, though it was only fair to state that the stations of the London line were approached by lifts, which, no doubt, added considerably to the cost of working. Their locomotive expenses were 3·35d., against 6·3d. on the City and South London. The great economy there arose from their having attached the motors to the axle of the carriages, instead of having separate locomotive motors, as used on the City and South London line. The percentage of working expenses to revenue was 66·84 per cent., but he was glad to say the directors saw their way to bringing that item down to 60 per cent. The train service for the past half-year had given general satisfaction. Although they had been running trains every five minutes, 96 per cent. of them were run to time. He believed there was no other line in the kingdom which had the same record of punctuality, and the result was that their railway was very popular with the public. They felt that they had done something to lower the charges of the port by the facilities of the railway, and anything they could do in that direction would be done. The directors thought the time had now arrived when the southern extension of the line should be constructed. The chief reason for that was that their Parliamentary powers would expire in June next, and either they must proceed with the work at once, or go to Parliament again for power to extend the time, which would involve some expense. The new line would be five-eighths of a mile in length, and the engineer's estimate of the cost was £87,000. There was also the cost of the land, easements, and engineering expenses, which were put down at £10,000, making the total cost of the extension close on £100,000. They hoped to be able to run this line at an additional cost in working expenses of £110 a week, including the cost of the stations, and the interest on the capital outlay; in other words, anything they made over £110 or £120 a week would go towards paying a dividend on the capital invested. They had no intention of further extending the railway, which, when the new portion was completed, would cover the whole line of docks, and have connection with good feeders at either end.

Mr. Richard Hobson seconded the motion, which was carried.

The Chairman then moved that dividends, as stated above, be paid, and Mr. Hobson seconded.

Mr. Wm. Bartlett thought 2 per cent. was a very small dividend. He and other shareholders were led to hope from the prospectus that they might look for a dividend of at least 6 per cent.

The Chairman, in reply, said it was true that the estimate of cost had been put down in the prospectus at £450,000, whereas it had been £600,000; and as to the 6 per cent., that was based on careful calculations; but unfortunately, being a new undertaking, things did not come out as they had anticipated. The cost of working had been very much more than they expected; but all things considered, he contended that the company had been most successful, and with the confidence of the shareholders, he had no doubt they would do well in the future.

The motion was then agreed to, after which Mr. Edward Lawrence and Mr. G. H. Robertson were re-elected directors.

Subsequently a special meeting was held, at which resolutions were passed in favour of the proposed extension being proceeded with, and that 7,500 ordinary shares at £10 each (being the unissued portion of the company's original capital) be issued, present shareholders to get priority in allotment.

Newcastle and District Electric Lighting Company.

The annual meeting of the Newcastle and District Electric Lighting Company, Limited, was held on Monday last at the offices of Messrs. Leadbitter & Harvey, Westgate Road, Newcastle, Mr. J. D. Millburn presiding.

The Secretary (Mr. James Patterson) having read the notice convening the meeting,

The Chairman, in moving the adoption of the report, said the output of the company in 1891 was 206,000 units, at a cost of 3·39d. per unit; in 1892 it was 290,000, at a cost of 3·11d. per unit; in 1893, 388,000, at a cost of 2·63d.; and in 1894, 431,239, at a cost of 2·45d. per unit; so that while the production had been steadily increasing, the cost had greatly decreased, till it had reached 2·45d. per unit, which was the cheapest price at which electricity had ever been produced. As they went on increasing in production the cost would still further decrease, and they would have the satisfaction in time of making a reduction in the price charged to the customers. This continuous reduction in cost of production had not been achieved by any undue capital expenditure, as taking the capital expenditure of the company in conjunction with the amount of electrical energy produced, it would compare most favourably with any company or corporation in the United Kingdom. It was very satisfactory to know that no harm to the gas company had ensued, because that company was paying splendid dividends, and was more prosperous than ever. Whether it was the rivalry or a desire to emulate their own company in their beautiful light he did not know, but certainly the public had been better served, and the shareholders of the gas company had been none the worse. The whole of the machinery, boilers, &c., were in a thoroughly satisfactory condition, and it was pleasant to mention—and this Mr. Parsons would be prepared to prove—that the mains of the company were in the best possible condition, and quite as good to all appearance as the day when they were laid underground. Of course, there would have been some depreciation, but it was not apparent. A great deal of their capital, of course, was sunk below the streets in those mains. There were miles and miles of cables, and they were most successful in the manner in which they laid down their tubes and the special joint boxes. They had a special engine for blowing the air through those mains in order to keep everything perfectly dry and tight. They had great reason to thank the foresight of their managing director (Mr. Parsons) for that, for some of their neighbours had not been so successful in that respect. The condensing plant was doing all that was expected, and, as the operations of the company increased, it was satisfactory to know that all the new machinery could be of the condensing type, Mr. Parsons having taken the precaution when making the drift to the river to make it large enough to meet future extensions for some time to come. The increase of 1894 over 1893 was only at the rate of 11 per cent., for which he was to some extent responsible. They found that a great many of the customers had far too much light, probably owing to the installations having been put in on too large a scale. They advised the customers to reduce their light by 30 or even 50 per cent., when they would be quite pleased with the light and have less to pay. Many, he believed, had done that. In the course of the year they had had their shares quoted on the local Stock Exchange, and the present price of the shares was placed at a fairly satisfactory figure. The price of the light was cheaper in Newcastle than in any other place in England, and in a year or two they hoped to make it still cheaper. They hoped presently to derive a large income from electricity for cooking purposes. They had not yet got hold of the right motor for driving machinery, hoists, &c., but they believed the time was soon coming when they would get it, and then the finances of the company would be in a considerably better state in consequence. With regard to the tramways, if the corporation would allow them to run overhead tramways with overhead wires, as at Milan, Genoa, and many Continental cities, they could do it very well and cheaply, but they could not see their way to do it properly underground. That was the reason, perhaps, why they had not taken the matter up. The prospects for the year were good, and they hoped to extend their business considerably. He moved the adoption of the report, and that a dividend at the rate of 3½ per cent. for the half year, making 6 per cent. for the year be declared.

Sir Benjamin Browne seconded.

Mr. F. M. Laing asked if it would not be advisable for the company to undertake the putting in of installations.

The Chairman thought the decision they came to at first not to do so was one which they had not regretted. He mentioned that Mr. Patterson, Mr. Hunter, and Mr. Parsons were at all times anxious to give all information about electric lighting.

The report was adopted, dividend declared, and Col. W. M. Angus and Mr. J. B. Simpson re-elected directors.

An extraordinary meeting was then held, at which it was decided to increase the capital from £50,000 to £100,000.

Replying to a vote of thanks, the Chairman paid a high compliment to the officials, Messrs. Parsons, Patterson, and Hunter.

Yorkshire House-to-House Electricity Company.

An ordinary general meeting of the shareholders was held on 5th inst. at the offices of the company in Whitehall Road, Leeds. Mr. Grosvenor Talbot, who presided, in moving the adoption of the report, said they had been able to earn a dividend of 4 per cent., but what was even more satisfactory to the directors was that in addition to the dividend they had also earned almost an equal amount which they were applying to other purposes. They were writing off this year the entire balance of their preliminary expenses. They had also been able to place a certain amount to the reserve fund. He believed that the result of this, their first complete year

of working was equal to the result of almost any country station, at all events, in England. During the whole time of their working the supply had been efficient and practically unbroken. On the 31st December, 1893, as the result of eight months' working, they had installed what was equal to 10,647 8-candle power lamps. At the close of last year they had 19,858 lamps installed. They delivered, in units, in the eight months of 1893, 125,000; and in the twelve months of 1894 they delivered 291,113; that was to say, in 1893 they delivered 15,620 units per month; and in 1894, 24,260 unit per month. That statement of the amount per month might be a little misleading without explanation. In 1893 there were four good months in which they were not working, and therefore the comparison was rather too favourable for last year's working, but the increase was eminently satisfactory. They had now, in immediate prospect, the whole of the lighting of the Leeds Town Hall and Municipal Buildings, equal to about 6,000 8-candle lamps. They had also offered to the Corporation to light any portion of the streets or markets which they chose, with arc lamps, and he trusted that that would be considered by the corporation, for they must remember that arc lighting, in the quantity of light given, was extremely cheap, and that they could place more lights in the streets by arc lamps at the same price than they could by lighting the district with gas. Messrs. Fowler had agreed to take their 100 horse-power engine, and to replace it with a 400 horse-power engine, and that was now about to be done. They felt that that would be of enormous advantage to them next winter. It would be observed from the report that they had received an advance from their bankers on the security of a mortgage debenture. The directors consulted with the bankers at the time when they wanted a small amount more money, and they came to the conclusion that it was far more to the advantage of the company that the money should be borrowed from the bankers rather than go to the shareholders and the public and ask them for more capital. They hoped the shareholders would agree with them that they had done a wise thing in not raising share capital, but should wait for the time when they would have to raise a much larger amount. He believed that had been to the advantage of the company. To show that there would be no difficulty in raising capital when they required it, as a dividend-paying company, he mentioned that the shares of the Liverpool Company stood at 40 per cent. premium, and the Newcastle and District Company at 25 per cent. premium; therefore, he thought, they might go into the market with the greatest possible confidence for any quantity of money they might want. As to the future, the directors felt that the price of the current was one of the great objects which they had to deal with, and they felt sure that by reducing the price they would immensely increase the sale. Another matter which they had considered was the necessity of extending their mains in certain directions. They proposed some time during the next spring to extend their mains from the top of Briggate up into Chapeltown. They had also taken the mains up to Woodhouse Square, and they proposed shortly to take them up Clarendon Road. The question of extending their plant was one which the directors would have to consider before very long. He felt sure that with an enlightened and courageous policy the shareholders need have no fear of the stability or usefulness of the property which they held.

Mr. R. W. EDDISON seconded the resolution, which was adopted.

Waterloo and City Railway Company.

THE second ordinary general meeting of this company was held yesterday week at Waterloo Station. Mr. W. S. Portal presided.

Mr. F. J. MACAULAY (the secretary) read the notice.

The CHAIRMAN, having explained the position of the capital and accounts, and remarked that no call was likely to be made in the current half-year, said the contract for the construction of the tunnels from the eastern side of the approach to the Richmond line station at Waterloo to the terminus of the railway in the City was let to Messrs. Mowlem on June 1st, 1894, and they have undertaken to complete the works, including all risk of damage to buildings overhead, by December 31st, 1896. The contractors commenced operations by constructing a large timber stage in the River Thames above Blackfriars Bridge, on which they have erected all their engines and machinery for the construction of the tunnels, including air-compressing machinery for driving through water-bearing strata, electrical appliances for lighting the tunnel, and running the excavations to the shafts, &c. From this stage two large circular shafts, 16 feet in diameter, were sunk on the line of each of the tunnels, and the driving of the up tunnel in each direction was commenced on November 28th. The material through which the tunnel is being constructed is the solid clay entirely free from water, and in the Waterloo direction it has cleared the river, and is now underneath the wharf on the south bank of the same. Towards the City the tunnel is also making rapid progress, and is approaching the northern bank of the Thames; altogether 670 feet have been driven and lined with cast-iron. A little delay has been experienced in the delivery of the iron, so that it was not till last week that the down tunnel, that is, from the City to Waterloo, was started. This, however, is now in progress at both faces, and as the ironwork is coming much more rapidly, there is every prospect that the work of the down tunnel will progress as favourably as that of the up tunnel. The material as excavated is sent up the shaft and carried away in barges. The work is carried on without cessation day and night, except between 6 o'clock on Saturday evening and midnight on Sunday, and so far everything has gone on satisfactorily and without mishap.

The report was adopted after a few remarks from shareholders. The other formal business was transacted, and the usual votes of thanks closed the meeting.

Isle of Man Tramways and Electric Power Company.

THE report of the directors states that the available profit from May 1st to December 31st, 1894, including a sum of £526 12s., being premiums on shares sold, amounts to £11,034 0s. 10d. Out of this profit an interim dividend of 6 per cent. on the preference shares, and 7½ per cent. per annum on the ordinary shares, amounting to £4,213 15s. 3d., was paid for the half-year ending October 31st; also a sum of £1,666 13s. 4d., being interest on debentures up to December 31st last, and £43 9s. 10d. interest on mortgages (balance), making a total of £5,923 18s. 5d. The directors recommend that a further dividend at the rate of 6 per cent. per annum on the preference shares, and 7½ per cent. per annum on the ordinary shares for the remaining portion of the financial year ending December 31st, amounting to £1,437 10s., be now declared and payable on the 28th inst.; that £2,000 be carried to a reserve and renewal fund, and that the balance of £1,672 12s. 5d. be carried to profit and loss new account for the present year. Owing to unavoidable delays, the passenger traffic between Groudle and Laxey was not commenced until July 28th last, and this part of the line being the most important section, the profits are much less than what may be anticipated in future years. Last season, owing to the limited number of motor cars, the management was unable to cope with the passenger traffic. The board, therefore, has ordered four new open motor cars of an improved type and larger carrying capacity, from Messrs. G. F. Milnes & Co., Birkenhead, and the electrical equipment from Messrs. Mather and Platt, Limited, Salford. The passenger traffic on the electric line during the winter months has exceeded the expectations of the directors, who have also to report that they are confident that the revenue to be derived from goods and merchandise traffic will be substantial. Arrangements are being made to meet the wants of the districts through which the tramway passes, together with the surrounding neighbourhoods. Negotiations are pending for the erection of a convenient station and all necessary accommodation at the Laxey terminus, and arrangements are now in progress for an approach road to the terminus. This road will lead into the heart of Laxey, and will meet the fullest demands for vehicular and pedestrian traffic. Convenient waiting rooms at important points along the line will also be shortly erected. An arrangement has been made between this company and the Derby Castle Company for the erection of a large waiting room and other accommodation at the Douglas terminus. After providing for the dividends on preference and ordinary shares and interest on debentures up to December 31st, and carrying £2,000 to reserve and renewal fund, an available sum of £4,080 11s. 10d. (over and above the balance being carried forward of £1,672 12s. 5d.) remains in hand to meet any necessary outlay on rolling stock, &c.

Stock Exchange Quotations.—Applications have been made to the Stock Exchange Committee to appoint a special settling-day in and to grant a quotation to:—British Aluminium Company, Limited, 15,000 7 per cent. cumulative preference shares; Westminster Electric Supply Company, Limited, further issue of 8,000 ordinary shares, Nos. 60,001 to 68,000. Application has also been made to have the following quoted in the official list:—W. T. Henley's Telegraph Works Company, Limited—3,000 7 per cent. preference shares, Nos. 1 to 3,000; and £50,000 4½ per cent. mortgage debenture stock.

Electrolytic Caustic Soda and Chlorine Trust, Limited.—At an extraordinary general meeting of the above company, held at the offices of the company, 23, Queen Victoria Street, E.C., on January 3rd, 1895, the following special resolution was duly passed: "That the company be wound up voluntarily." And at a subsequent extraordinary general meeting held at the same place on January 24th, 1895, the resolution was duly confirmed, and Mr Randal Vogan, of Walton Lodge, Surbiton, Surrey, was appointed liquidator of the company without remuneration.

Bath Electric Lighting.—The annual meeting of this company was held on Wednesday at Bath, Mr. T. O. Callender (chairman of the company) presiding. The report stated that there was an available balance of £563, but the directors recommended that no dividend should be declared, that balance being carried forward. After some protests from shareholders that after four years' working there was still no dividend, the report was adopted.

The City of London Electric Lighting Company, Limited.—The board have resolved, subject to the completion of the audit, to recommend to the shareholders the payment of the following dividends for the past half-year: At the full rate on the 6 per cent. preference shares, and 5s. per share on the ordinary shares, being at the rate of 5 per cent. per annum.

TRAFFIC RECEIPTS.

The **City and South London Railway Company.** The receipts for the week ending February 10th, 1895, amounted to £1,022; week ending February 11th, 1894, £937; increase, £85; total receipts for half-year, 1895, £6,041; corresponding period, 1894, £5,727; increase, £314.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending February 10th, 1895, amounted to £859; corresponding week last year, £691.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 8th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited were £3,283.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation February 6th.	Closing Quotation, February 13th.	Business done during week ended February 13th, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	101 —104	101 —104	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	40 — 41 xd	40 — 41	40⅝	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	75½— 76½xd	75½— 76½	76⅝	75
2,993,560£	Do. do. Defd.	Stock	...	...	...	6½— 7	6¾— 6⅞	6⅝	6 5/16
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	6½% §	...	11½— 12	11½— 12	12	11⅝
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	109 —113	109 —113	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	10%‖ §	... §	...	2½— 3½	2½— 3½	3¾	3 1/16
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	147 —152	148 —152	148¾	148½
224,850	Consolidated Telep. Const. and Main., Ltd.'	10/-	2 % §	2 % §	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14	13¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	20 — 21	20 — 21	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4 %	4 %	...	4 — 4½	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	...	9½— 10	9½— 10	9⅝	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	103—106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	2⅝% §	...	8½— 9	8½— 9	9	8¾
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	...	16¼— 16½	16½— 16½	17 1/16	16¼
70,000	Do. 6 % Pref.	10	6 % §	6 % §	...	17½— 18	17½— 18	17 1/16	17½
102,100£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	104 —106 xd	105 —108	...	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	124 —127	124 —127	124½	124
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	16¾— 17	17 — 17¼	17¼	16⅞
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	102 —106	102 —106	105½	105
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	123 —126 xd	123 —126	125¼	124½
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	102 —106	102 —106	105½	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	106 —109 xd	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	112 —115%	112 —115%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅞% §	4⅝% §	...	9⅜— 9⅝	9½— 9¾	...	...
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	...	16⅜— 16⅝	16½— 16⅝	...	...
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	...	21¾— 22¼	21½— 22¼	...	...
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	106 —109	107¼	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	50 — 52	52 — 54	53	52¼
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	105 —109	105 —109	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼— ⅜	¼— ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1½— 2½	1¼— 2½	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	5 % §	5 % §	5 %	5⅜— 5⅝	5⅜— 5⅝	6½	5½
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	16¼	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	15¼	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	6 — 6¼	6 — 6¼	6¼	6 1/16
1,100,000£	Do. 3½ % Deb. Stock Red.	...	...	...	...	105 —107	104 — 106	105½	104¼
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	½ — ⅝	9/16— 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	105 —108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	...	3 — 4	3 — 4	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	117 —122	118 —123	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	86 — 91	86 — 91	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	0 %	...	4 — 5	4 — 5	...	...
238,300£	Do. do. do. 5 % Debs.	100	...	...	...	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2½	1½— 2½	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	98 —103	98 —103	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	...	10¼— 10¾	10¼— 10½	10⅝	10 5/16
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6¼— 6¾	6¼— 6⅝	...	...
33,129	Do. do. do. 5 % Def.	7½	...	...	...	4¼— 4⅝	4 — 4½	4½	...
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	100 —104 xd	100 —104	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	100 —104 xd	100 —104	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	⅜%	...	1 — 1¼	1 — 1¼	1	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10¾— 11¼	10¾— 11¼	...	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	...	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	104 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5 — 5⅛	5 — 5⅛	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	14 — 15	13½— 14½	14 1/16	13⅞
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15¼— 15⅝	15¼— 15⅝	15⅝	15½
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	133 —136	133 —136	134	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	6 %	7 1/16— 7 7/16	7¼— 7⅜	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	...	9¾— 10¼	9¾— 10¼	10 3/16	10
100,000£	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	...	...	...	118 —120	118 —120	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7 — 7½	7 — 7½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	7½%	4½%	6½%	7¾— 8¼	7⅞— 8¼	7⅞	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8¾— 9¼	8¾— 9¼	8⅝	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	7½— 8	7½— 8	7 13/16	7 11/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Feb. 6th.	Closing Quotation, Feb. 13th.	Business done during week ended Feb. 13th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 %§	6 %§	...	2⅝ — 2⅞	2⅝ — 2⅞	2¾	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %§	6 %§	...	2⅜ — 2⅝	2⅜ — 2⅝	2⅝	2 $^{9}/_{16}$
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	115 —118	115 —118	...	...
630,000/	City and South London Railway	Stock	⅝%	⅝%	1¼%	48 — 50	48 — 50	48½	48
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 %§	7 %§	...	3 — 3½	3 — 3½	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	102 —107	102 —107	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼ — ½	¼ — ½	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½ — 2	1½ — 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	...	$^{3}/_{16}$ — $^{5}/_{16}$	$^{3}/_{16}$ — $^{5}/_{16}$	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	1⅛ — 1⅜	1⅛ — 1⅜	1 $^{3}/_{16}$	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	1 — 1¼	1 — 1¼	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	½ — 1½	½ — 1½	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	...	...	...	6½ — 7½	6½ — 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	...	9½ — 10½	9½ — 10½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	22 — 23	22½ — 23½	23	21½
200,000/	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	2 %	8½ — 8⅝	8¾ — 8⅞	8 $^{13}/_{16}$	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	10 %§	7½%§	...	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	41 — 43	42 — 44	44	43⅜
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	104 —107	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2⅜ — 2⅝	2⅜ — 2⅝	2⅝	2½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

CROMPTON & CO.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.
Electric Construction Corporation, 6 % Debentures, 84—87.
Electric and General Investment, shares of £5 (£1 paid), 1½—2
House-to-House Company (£5 paid), 3¾—4.
Do. do. 7 % Preference, of £5, 7¼—7¾.
Do. do. 6 % Debentures of £100, 107—109.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7—7½; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 7¼—7½.
London Electric Supply Corporation, £5 Ordinary, ¼—½.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 98—102.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 4¾—5¼.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

DISCUSSION ON MR. J. E. KINGSBURY'S PAPER ON "THE ORIGIN AND DEVELOPMENT OF THE TELEPHONE SWITCHBOARD."

(*Concluded from page* 179.)

Mr. G. L. ADDENBROOKE said the paper was a very solid one, and he joined with other speakers in acknowledging the lucid way in which it was put together. Upon the subject of switchboards he had expected to hear something of a board afterwards used in electric lighting; this board had a second set of strips laid underneath the top and at right angles, plugs slotted longitudinally were used, making a spring contact, and passing through holes in both strips. All these boards, of course, were gradually swept away. He had made one or two attempts himself to design boards of one sort or another, but there was no doubt English telephonists were greatly handicapped in comparison with their American brethren. Unfortunately in the early days of telephony the telephone company seemed to consider that so far as the staff were concerned, the finality of things had come, and if any improvements were to be made they must come from outside. There was no want of ability on the part of the servants of the company, but the management did not encourage any work of an ingenious kind. It was desirable that people should know how differently the Western Electric Company had acted in this matter. He, himself, was in America about four years ago, and having an introduction to the president of the company from Mr. Kingsbury, the former showed him over the works of the company, and explained how they worked. They had a special department dealing with inventions, and that department was in communication, as far as possible, with telephone companies all over the country, and received information and complaints from them. It was the duty of this department to go through the mass of complaints and suggestions, and to see how far those suggestions could be put into practical form, there was no doubt that had been a most successful policy. At the present day, when they looked back at all that had been done in the way of telephone switchboards, they might almost say that the progress of telephony had rested with the Western Electric Company and with the affiliated companies, whose various superintendents, with their knowledge of practical working, had been able to make suggestions from time to time. It used to be a great sorrow to him that English electricians had not the chance that Americans had. Probably matters were altered now. At any rate British people ought to take a leaf out of the book of the Western Electric Company in that matter. He did not think Mr. Kingsbury had brought out, as far as it might have been brought out, the immense complexity, yet simplicity, of the multiple board. It was an enormous problem when they had 4,000 or 5,000 subscribers on each board, into many couplings for each subscriber, the cross couplings to be got right and made so that they would stay right. This paper laid the groundwork upon which a mass of interesting material might be built up. Somebody ought to say something of the exchange systems of London. There was no doubt London presented a different telephone problem from that of any other system, and the officials of the London companies had had to deal with problems which were not met with in Paris, New York, Boston, or in any other city. In his time they used gutta-percha cable, and therefore had considerable capacity; it was exceedingly difficult to get below that capacity, and they could not get above it. Towns like New York or Paris were not sufficiently large to introduce any great difficulty in putting in the lengths of cable necessary to reach out from the dense areas; but in London there were many centres that must all be connected together by trunk lines, and they had to carry great masses of trunk lines from one end of London to the other, three or four miles or more. No doubt the system had been simplified since by the introduction of lower capacity and by the use of metallic circuits, but in his time the capacity was such that when they got beyond two or three miles of cable, conversation was certainly very deplorable, and they were always receiving complaints about it. In that way they had to meet a problem that he did not think had been met with in the same way anywhere else. To meet these difficulties the central trunk exchange was decided upon, and was started at Oxford Court, which was very much like the head to the different parts of the body. They had 18 or 22 exchanges in London, a greater number than any other city by a very large proportion, and these had all to be connected together and arrangements made so that any one exchange could be connected to any other, and they had a double system for almost everything, as in London by far the greater number of calls went through the trunk system. That problem had been met in London, and he thought if they could have a paper which would deal with these improvements from some one who was thoroughly up to date, it would be an exceedingly interesting communication, and would show that English electricians were not altogether playing a secondary part in telephonic development.

Mr. CLAY said as this was a historical paper, he should like to refer to a modification of one switchboard which Mr. Kingsbury had omitted. The Bell board was subsequently used to a very large extent in England; at Liverpool a slightly modified form was used, the springjacks were altered, and the strips were entirely

done away with, and the plugging was done direct with a cord from one springjack to another. He remembered that somewhere about 1882 it was pretty generally agreed, so far as England was concerned, that any switchboard introduced with cords was practically inadmissible for the telephone business, because of the great difficulty of keeping them in order. Mr. Kingsbury had said, what was unfortunately true, that most of our good things came from America, but if he might say so, that was only because America was a little in front of us in point of time. There was the germ of the multiple board in the Hawes board, and he had no doubt that was as good a board as the original board in America. Then with regard to the branching system, there was a system designed by Mr. Watts, of Newcastle, before the American system was heard of here.

Mr. Aitken said they had listened to a very interesting historical paper, but they must all feel sorry that Mr. Kingsbury stopped where he did. They would like to know a little more of the modern switchboards they had in America, the divided switchboard and the visual signal board; these were things that were new, and to which they were not accustomed. Mr. Kingsbury had spoken of one or two points of development as though they belonged specially to the year 1894. The use of the test ring on the front of the springjack was not new, and had been known for at least three years both in this country experimentally, and also in Stockholm. The branching system, too, as Mr. Clay had said, was not new; it had been known here for several years, and had been in successful working for at least two years. There were lots of improvements that Mr. Kingsbury had not mentioned. Flat boards had been introduced considerably, the advantage being that with half the number of springjacks they could work the same number of subscribers as with the upright board. The operators worked from both sides, and therefore there was a considerable saving of cost, and in a given space they could get nearly double the number of subscribers, and as space was very valuable in London, that was a serious consideration. Boards worked on the single cord system were speedier in operation, and also there were only half the number of cords in use. Most of the speakers had referred to the difficulty of keeping cords in order, and they must see that when there were only half the number in use the difficulty was much less.

Mr. J. G. Lorrain joined with others in praise of Mr. Kingsbury's paper, which was one of the best they had ever had on the subject of telephony, and his hope was that they would have a great deal more upon that subject. On the question of switching arrangements, he thought it would be a pity if an historical paper were allowed to pass without any mention of the old switching arrangements used before the advent of the telephone. It was known to a good many people that in Glasgow (and he believed also in Newcastle), there were two very large exchanges worked by Wheatstone A B C instruments. His recollection of the Glasgow exchange was that there were about 120 subscribers, and that for an A B C instrument exchange was a very large one, considering the difficulty of working. With regard to one of those early boards, he was rather astonished to hear it spoken of as the Bell board. It was first known as the Williams standard switchboard. It was, as had been said, a very troublesome arrangement. They could get 75 exchange lines on by employing two operators. With regard to the advantage of a circular plug being apparently an insignificant one yet really of great value, that was very strongly borne out by the fact of the trouble of operating that board by means of the old flat plug. Mr. Kingsbury seemed to think the first exchange was that in Coleman Street, London; as a matter of fact, the Manchester exchange which he, Mr. Lorrain, started was about a week or a fortnight before it; then came the London exchange and then the Liverpool, or else the Paris, was third. Mr. Kingsbury spoke of the multiple board originally designed never having been used in England; he rather thought Scribner, in 1880, brought over a model of that board, and that it was shown at Clark, Muirhead's. Coming to the point about the multiple switchboard, Mr. Kingsbury said people would be surprised to hear that metallic circuits were provided for in 1879. Really that was not surprising at all, from the fact that Bell was working very hard at that period on metallic circuits, and carried out a great many experiments; and this brought to his mind a point about which he would like to get some information. He referred to that metallic circuit arrangement where they had, as on the St. Margaret's line, the crossing of the lines, spoken of as the Post Office system. He thought that was the patent of Bottomley, Heys, and Moseley, dated July, 1880, but the idea was much older even than that, and he would like to find out where it came from. He carried out a number of exchange lines on that system in Edinburgh in October or September, 1879; he got the idea in July, 1879, from Mr. Tracy, an American, who said he had seen it either in Chicago or some other American city. Undoubtedly it was in existence at least early in 1879, perhaps earlier. He was rather sorry Mr. Kingsbury had not referred to some other switchboards. In tracing out the development of switching arrangements, it was necessary to bear in mind a large number of other switchboards brought out by other men. He should have liked more information about the Law system, and Mann's and other modifications of it. He could not help thinking there was more in that than in the existing system. He had recently had an opportunity of seeing two typical systems, one the Western Electric, in Cincinnati, and the Law system at St. Louis, and he must say he never saw any exchange whose working came within measureable distance of the system at St. Louis. With regard to the working of the system in this country, whenever any criticism was raised on the subject, they always heard that *London* was so difficult. But the same service existed all over the country. Anyone who had had any experience of the kind of service they could get in Switzerland, Germany, or Sweden, would be absolutely shocked by the service here.

The President said it was to be regretted that the discussion was so limited, but it was necessary that it should be completed that evening, as the subject of the next paper was an entirely different one. It was not the fault of the engineers that so little had been done in this country with regard to telephony; but the fact remained that when those electrical engineers, who were users of the telephone in London, compared the service with that of the Continental towns, they felt the difference very bitterly. It was the difference between light and darkness. They had heard nothing of the important question of trunk lines, where they were told the fault lay, whereas elsewhere in Europe they had gone ahead to such an extent, that that was a general luxury of modern life, which in England was only the luxury of the few.

Mr. Kingsbury, in replying, said he was sure if those who had spoken really knew the difficulties which were met with in London, they would have more consideration for the people who were running the system. He had only set out to deal with the development of switchboards and that was the reason he had not in his paper referred to several things upon which other speakers had spoken. He thought, probably, Mr. Lorrain was right in saying that Scribner's board was brought to this country in 1880. Mr. Aitken objected to his omission of the single cord and the flat board. The flat board he would put to electric light men in this way: there was an engine they could get at a low price, but which would cost a large amount for fuel. That was the flat board. The single cord board was one of the inventions with which Scribner's name was particularly associated, but it had disadvantages, and was not in the line of switchboards which had led to ulterior developments, and, therefore, was not included in the switchboards he had brought before them that evening. He thought Mr. Aitken had entirely misunderstood the drift of his observations about the ring on the front of the springjack. Mr. Clay had put the matter very reasonably in saying that most of the good things in telephony came from America because America was a little in front of us in point of time. It was a fact that the telephone was born, bred, and brought up in America. The problems which had to be overcome arose there first. It was the home of the industry, and they had gone systematically to work to develop the telephone. He did not think we ought to grudge the Americans their success in one department, seeing that for the same reasons we had so many successes of our own. In conclusion he thanked his audience for their patience and the speakers for their very kind remarks.

The meeting was then adjourned.

The Northern Society of Electrical Engineers.

Electricity as Applied to Mining, by G. S. Corbett, Member of Council. (Paper read Monday, February 11th.)

Electricity has been extensively used in mining operations and the cases in which it is so applied are rapidly increasing, so much so, that it seems beyond all doubt that in the near future electric mining work will form one of the important branches of our business. I therefore feel no apology is necessary for bringing this subject before the notice of the members of this society. It is, of course, impossible for me to deal at all fully with the different branches of the subject in the time at my disposal this evening, but I wish to look briefly at what has been done up to the present and then consider somewhat in detail certain points that seem to me important. Electricity has been used in mines for:—

1st. Signalling.
2nd. Telephones.
3rd. Blasting.
4th. Lighting.
5th. Transmission of power.

1st. So far as I have been able to ascertain, electric signals were introduced into some Yorkshire collieries about 20 years ago, and have since been extensively adopted. It would be very interesting to trace the various steps by which this system of communication has gradually been worked up to its present state. How the bichromate battery gave way to the Leclanché, the staples carrying the wires were replaced by insulators, and the mechanically good bells of to-day mounted usually in cast-iron cases, were evolved from the flimsy contrivances called by courtesy "electric bells." The arrangement of the apparatus is now so well known that a very brief description of the simplest form of signalling, viz.: Engine plane signalling will suffice. In the engine-house is fixed a powerful bell with a 6 inch or 8 inch gong, a battery of Leclanché cells, and a plug switch. Along the roadways, two galvanised iron wires are tightly strained on small bobbin insulators and very securely bound on these insulators in the usual manner. At the distant end is placed a strong ringing key. Signals can be given by means of this key or by pressing the wires together at any point on the roadway. The size of iron wire varies from No. 8 to 11. The size of the bells whether of the single stroke or trembler pattern is usually determined by the colliery manager. A plug switch is necessary so that at night and other times when the signal may not be required, the battery may be disconnected and leakage prevented. In most cases, underground moisture is to be found at some parts of the roadway. The leakage circuits so caused are a constant strain on the battery and, consequently tend to break it down. Any number of bells can be fixed at various points to ring in any desired manner.

The present Coal Mines Act provides that signals must be arranged to ring in both directions, that is, a bell at each end. The advantage of electric signalling for mines, is the speed at which signals can be transmitted over any distance. For example, in some of the Durham collieries where the roadways extend for four miles from the shaft, signalling by the old "Rapper" method, often involved three or four men stationed at different parts of the roadways to transmit the signals forward. With the electric method, of course, it is just as easy to signal four miles as 100 yards.

This speed in signalling also tends very largely to safety in working;

in case of accident, the haulage rope carrying loaded trucks can be stopped by pressing the wires at any point along the roadway, and in my own experience *this* has been directly responsible for saving several workmen's lives. There is the further advantage that the attendant at each station knows by the signal where the train is starting from or proceeding to as the case may be.

This system of underground communication has now been extensively adopted by collieries all over the country, perhaps more particularly in South Wales, and so little difficulty occurs in the installation and maintenance of this apparatus that most collieries manage this work without any outside electrical assistance.

2nd. Telephones have also been used very largely for surface work for communicating with the various departments, but only to a limited extent below ground. So many collieries have electric signal wires running into the workings and as it is such a simple and inexpensive matter to attach telephones to the signal wires, it is surprising that more use has not been made of these instruments for underground work.

Pocket telephones, that is a small case containing a receiver and a short length of flexible wire for attachment to the iron wires, are also most useful, but comparatively few collieries have them. Where telephones have been adopted the saving of time has been enormous and the convenience very much greater than was expected.

3rd. Blasting.—Following the strong recommendation almost amounting to an instruction of Her Majesty's Inspector of Mines, most collieries have now adopted the electrical method of shot-firing. Shot-firing in mines has been the cause of numerous accidents occasioning in too many instances wholesale destruction of life, that the subject deserves some consideration at our hands. I do not wish to say that the sad accidents which have occurred were due even indirectly to electricity.

There has been even in this small branch of electrical work a battle between high and low tension. High tension was adopted first, but is now being gradually replaced by low tension apparatus. Many important advantages are possessed by the latter, and I think in the near future high tension exploders will be very little used. Exploders are small magneto machines with a simple shuttle-armature which is wound with fine wire for high tension and comparatively coarse for low tension. One end of the armature coil is connected to the frame and the other led through the spindle and an insulated ebonite bush to a contact. In the high tension exploders this ebonite bush is one of the most fruitful causes of failure. Dampness is usually unavoidable, and as this ebonite bush is necessarily small breakdowns are frequent. I have had several hundreds sent to me for repairs with this fault alone. This is a difficulty which should be easily overcome. At the same time it does not occur in low tension.

Detonators are now being manufactured of a fairly uniform quality, but until recently enormous variations occurred. For example, one lot I tested about 10 years ago required current to fire them at from 2 to 80 volts, and within the last two years I have found a number of so called high tension detonators requiring from 300 to 400 volts, although 30 to 40 volts may safely be taken as the average pressure required.

High tension detonators are fired by means of a spark passing across the ends of the two wires inside the copper cap of ¼-inch diameter.

Low tension detonators are similar in appearance, but the ends of the above wires referred to are joined by a thin piece of platinum wire which is heated by the current. From a manufacturing point of view I think the low tension detonators are simpler, and so far as my own tests go, are of a much more uniform quality. It seems to me extremely difficult to ensure that the distance between the wires in a high tension detonator should be always uniform, but the most important advantage possessed by low tension apparatus is, that each detonator can be easily tested before use; I know of no test which can be applied to high tension detonators, and as mis-shots are very costly in themselves and also a source of danger, this advantage cannot be too strongly insisted upon.

This class of apparatus is generally used for firing some of the various high explosives which need not be described further than the remark that their name usually ends in "ite."

4th. Lighting:—One of the earliest attempts at colliery lighting was at the Earnock Colliery in Glasgow about 14 years ago, and I believe the plant worked very successfully for some time. The first colliery lighting job that I have any personal knowledge of was at one of the Durham pits. This was completed in or about the year 1882, and worked for a number of years. The dynamo was of the old B Gramme type with a wooden hub, series wound field magnets and coupled in parallel, supplying current for about 50 Swan lamps of the type then called 20 C.P.

The wiring was hardly done in modern style. It is true that the wires were run in casing; the casing had only one groove which was big enough for all wires. Fuses were entirely absent, the lampholders were of the original Swan spiral spring type and I think switches were considered altogether unnecessary; the engine stop valve had also to do duty for the main switch. A Paterson & Cooper's permanent magnet voltmeter with a loose keeper was also fixed.

It is unnecessary to describe in detail a colliery lighting plant, were I to attempt to do so my most grave and learned audience might think I had written them down as first year's students, but one or two special points are perhaps worthy of more than a passing remark.

Most collieries have a fan engine, with a large surplus of power, and it is often suggested that this be used for dynamo driving, but I think that there are very few cases in which it is advisable to do this. The average speed of a fan engine may be taken at 50 and of a dynamo at 1,000 revolutions, or a 20 to 1 ratio. This involves a countershaft, and fast and loose pulley, or a friction clutch. This gearing with the additional belting required often costs almost as much as a small engine and is not so satisfactory. 5 per cent to 10 per cent. variation in the speed of a fan is not uncommon, but this variation is far too great for electric lighting work. Again, there is the uncomfortable feeling of depending on one engine for light and ventilation. I therefore think that the best arrangement is to drive the dynamo with a separate engine.

Usually there is space in the fan engine house to receive an engine and dynamo and a more suitable place could hardly be found. The man is constantly in attendance and is, as a rule, not over-worked and can therefore do all that is necessary for the electric light plant. The steam consumption of a colliery electric light engine need not, as a rule, be considered, and an ordinary belt-driven engine seems to answer the purpose. I have found small vertical engines running at from 200 to 250 revolutions a very satisfactory type.

The dynamo should be compound wound for 100 or 110 volts, and should always have a fair margin for extensions, as these are very likely to arise. In plants for surface lighting only, the dynamo usually runs from dusk to daylight and from 6 p.m. to 6 a.m. is very lightly loaded. During these hours the steam consumption per unit generated is probably enormous from a central station man's point of view, but at night there is plenty of steam to spare at a colliery, and I do not think, unless in some special cases, it would pay to lay down a small set of plant for the light load.

As the electric lighting plant at a colliery has to stand a considerable amount of rough usage, it follows that the wiring should be particularly well done and the highest quality of material and workmanship employed. The advantages of distributing the lighting from certain points at which the switches and fuses are grouped, is, perhaps, more apparent in this class of work than in any other.

Alterations to certain sections of the plant, such as screening arrangements, are constantly being carried out and branch circuits have to be removed and refixed, and not infrequently the wires of the adjacent circuits are damaged by these alterations.

In almost all the places the lamps should be enclosed in very strong fittings, absolutely dust-proof, and with a thick outer glass which, in some instances, must be protected by a stout wire guard. In this district the screening and coal cleaning arrangements are undoubtedly the most important part of a colliery, from an electric lighting point of view. A liberal amount of light should always be provided, so that when the glasses become a little dusty, as is just possible, there may still be sufficient light to detect the impurities of the coal. No general rule as to the amount of light to be provided can be laid down as the screening arrangements vary so largely and also the quality of coal that has to be dealt with.

In South Wales, for instance, very little coal screening or picking is required, while in Leicestershire house coal collieries, the small waggons from the mine are drawn into a special shed for the purpose and the best pieces are carefully selected and packed by hand in the railway waggons adjoining. Between these two extremes there is almost every possible variation, so that each individual case has to be dealt with on its own merits.

In addition to the surface lighting arrangement of collieries electricity has also been extensively used underground for lighting the main roads, engine-houses, &c., close to the bottom of the shaft. The same remarks as to fittings, &c., apply with equal if not greater force underground. Where the shafts are comparatively shallow and the number of lamps is small, the underground lighting can easily be effected by a cable from the surface installation led down the shaft, but where, as in this district, 600 yards is quite an ordinary depth for a colliery shaft, and 100 16-C.P. lamps or the equivalent have to be provided, the cost of such a cable becomes a very heavy item. The conditions of underground lighting may be briefly summarised thus: The whole of the lighting is required during the day, but at night only a few lamps at each pit bottom or mouthing are used. During repairs, certain sections of the underground lighting may also be wanted during the night. These conditions imply that the best arrangement is, to have a cable connected with the surface installation sufficiently large to supply the whole of the lighting with only a small loss, say 4 volts, and to use lamps of the same voltage as on the surface.

To take a case which may be considered an average one, a shaft 600 yards deep, 25 ampères required at the bottom with 3 volts loss; the cable will be 37/13 size, and, allowing 1,300 yards of 2,000 megohms vulcanised rubber, will cost £342.

3 volts loss, cable	37/13	...	...	cost	£342
4 „ „	19/11	...	...	„	310
10 „ „	19/15	...	...	„	119

If 4 volts the figures will be 19/11 and £310. In addition to these figures there will, of course, be the cost of specially strong casing and the fixing thereof, as well as the lamps and wiring underground. Taking the cost of the latter at 30s. per lamp, it will be seen that the total capital outlay required for 50 lamps will be £425.

This is a fairly large sum, and owing to the present state of the coal trade, colliery managers are not inclined to lay it out in such work. It is, of course, possible to provide for a larger loss, say, of 10 volts in the shaft cable, and use, say, 110-volt lamps on the surface, and 100-volt lamps underground; the cable would then be 19/15, and cost £119. Assuming that the cables are provided for a 10-volt loss at full load, and that the lamps required all night are only 20 per cent. of the full load, it follows, of course, that when these lamps are burning, the volts at the pit bottom will be 108; but as this pressure would very soon destroy the lamps, it is necessary to either switch in a resistance or to wire them in duplicate, one set for 110, and the other for 100 volts. There is the further inconvenience that the other lights cannot be used at all unless almost the whole lot are switched on.

There are two other alternatives open: first, to lay down a separate engine and dynamo at the pit bottom; but this is generally impracticable. Second, to fix a separate dynamo to give 220 volts, and

couple the lamps two in series underground. This will effect a very large saving in the cables. In the case previously referred to, with the same percentage of loss, the sizes of cables would be as follows:

6 volts loss		19/15	...	...	...	cost £119
8	"	19/16	...	...	...	" 96
20	"	19/20	...	...	...	" 45

Usually it would also be practicable to allow the 20-volt loss, as during the night dynamo volts could be lowered by a resistance in the shunt.

It seems to me that for fairly large underground installations that it would pay to adopt this 220-volt arrangement, in spite of the fact that two dynamos would be running all through the night at extremely light loads, one for the surface, and one for the underground.

Again, it is quite an open question whether vulcanised rubber, enclosed in wood casing, is the most suitable form of conductor for shaft work, although, speaking from my own experience, I have had most excellent results from this quality of cable. There are, however, various other types of insulation and protection, such as lead covered and armoured, which certainly, to a colliery engineer, have the appearance of mechanical strength. They are, however, very heavy, and sometimes considerable difficulty arises through not properly securing them to the sides of the shaft. This type generally costs more money than vulcanised rubber, but in my opinion it is certainly very much open to question whether it makes a better job.

Where cables of a fairly good size have to be carried along the roadways of a mine, then I think it best to adopt the armoured type. In a paper of this sort I scarcely think it fair to mention the names of the makers of different kinds of cable. Remarks on the merits or demerits of individual firm's productions would only tend to ill feeling.

The question of providing suitable hand-lamps for miners is one that has occupied electrical engineers' attention for a long time, and although very much has been done in the way of experiment, and very many different types of lamps have been brought out, yet up to the present I know of none which I could with any confidence recommend to a colliery engineer to place in the hands of his workmen generally. For some of the officials, and for certain special purposes, underground portable electric lamps, fitted with accumulators, can now be obtained, which work fairly well if the instructions as to charging are carefully attended to, and the lamp itself is kept in a vertical position; but should there be a little carelessness on either of these points, trouble and annoyance immediately result.

Another very great difficulty is, that up to the present no practical apparatus has been devised which can be attached to such lamps to indicate the presence of gas.

5. *Transmission of Power.*—Mining engineers have for some time past been considering the possibilities of electricity as a means of transmitting power in their mines. A certain amount of work has been done, for the most part successful, but, excepting in a few cases, the plants installed have been of small size and of a somewhat experimental character. I mean experimental more from a mining engineer's point of view than that the electrical machines were of an unfinished or imperfect character, or, in other words, that the colliery manager was feeling his way as far as electricity was concerned.

Colliery managers, it must be remembered, are directly responsible for the lives of their employés, and, not unnaturally, looked with some doubt upon the new power, especially since every failure was by interested parties brought into prominence. Then the wildly incorrect statements made by electrical men have done much to deter electrical work. Colliery managers have been assured that the combined efficiency of engine, dynamo, cable, and driven machinery, would be 90 per cent. Such a statement is of course absurd, but its very absurdity is prejudicial to our interests, as the colliery manager naturally concludes that we know nothing of our business. Again, some electrical engineers have laid down power plant in mines of a very inferior character. They have not taken the trouble to ascertain the difficulties of working, the rough usage, the scanty attention and the large increase of power occasionally demanded. The result has been constant breakdowns with the consequent expense and annoyance. Such cases cannot be too strongly condemned; it is the whole trade which suffers, and not the individual that does the job. On the other hand, however, much good work has been done. One of the earliest, if not the first, power plant, was put in by Mr. Frank Brain, in the year 1882, at his Trafalgar Colliery, and this, I understand, is still at work, but has since been considerably extended.

Electricity has been applied to pumping, hauling (by fixed motor, and by locomotives), coal cutting, fan driving, and drilling. A full consideration of the problems involved in any one of these sections would be quite sufficient for a separate and elaborate paper; it is therefore obviously impossible for me to describe each in detail, but there are certain points common to all plants which may well be commented on. Electrical engineers who undertake this class of work are pretty well agreed that the current should be supplied at a constant pressure, and I think 500 volts a very suitable standard to adopt. This will, I think, be found in practice sufficiently high to make it commercially practicable to transmit power to the ordinary distances of a mine without an extravagant outlay in cable, yet not so high as to cause a dangerous shock; nor too high for the very small motors that are occasionally required for pumping small quantities of water. It must be remembered that one of the great advantages of electrical power transmission in mines is its flexibility. It can be as readily applied to small powers as to large, and if the volts are raised much above the limit I have suggested, practical difficulties will arise in the manufacture of motors under 2 horse-power. These small motors are really required in practical work; I have one or two motors working underground driving pumps which are only taking ¾ of an electrical horse-power. Cables: Quality and sizes of cables must be almost entirely regulated by the circumstances of the particular case. For shaft work I have found good vulcanised cables last remarkably well, while for the roadways of the mines where heavy currents are required cable insulated with bitumen, or one of the resinous compounds, protected with a heavy steel armouring, and laid directly in the ground, makes an admirable job. I think in all cases it is advisable to have insulated lead and returns; although I have myself one job where an uninsulated return is used, though with only moderately satisfactory results. The return consisted at first of a steel-wire rope, but on account of its very high resistance, presumably at the joints and splices, bare copper wires were used to increase the conductivity. In a mine it is impossible to insulate such a conductor, and, generally speaking, I think it pays to spend the additional capital required, and provide an insulated return circuit. For most of the operations required in mining a series-wound motor is the most suitable. For pumping and hauling it is an absolute necessity, as an enormous torque is required to start the load. In laying down any system of power plant, it is extremely difficult to obtain from the colliery engineer reliable figures as to the power required. Speaking from a somewhat intimate connection with colliery engineers, extending some 10 years back, I am inclined to think that a very large number of them never trouble to ascertain what power is being expended on certain operations. For instance, if pumping plant by ropes or compressed air is being laid down, care is taken that there is an ample margin of power, and so long as the work is being done without a breakdown, the colliery engineer does not measure the exact horse-power required for dealing with this particular quantity of water. Although it is a comparatively simple matter to determine the theoretical power required, the actual power is often a very much larger amount.

In pumping work, for instance, the friction of the pump and its gearing does not vary in any fixed proportion to the total horse-power.

A moment's consideration will show that the friction of the pump itself will be about the same whether the pump is worked against 50 or 500 feet of head. Pipe friction is also an item that requires careful consideration. In the majority of cases, electrical pumping work at a colliery is for a fairly large quantity of water on a comparatively small head, and the friction in the pipes may absorb quite as much power as the raising of the water.

In one instance under my own charge, the pipe friction is just double the power required to raise the water. In calculating the pipe friction I have used the following rule, which has the advantage of being easily remembered, and, as far as I have been able to check it, is very correct. It is due to Prof. Merivale, of Newcastle-on-Tyne, and is

$$\frac{G^2 L}{(3d.)^5} = H,$$

where
- G = gallons per minute,
- L = length of pipe in yards,
- d diameter of pipe in inches,
- H heat due to friction.

In haulage work the amount to be allowed for friction is also very variable. On a wet road which is badly kept, with rails allowed to get slightly out of gauge, or not free from small pieces of stone or coal, the power due to friction is enormous as compared with a dry and well kept roadway. Again, provision has to be made for the additional loads that may be put on the plant. For instance, in an endless rope haulage system it often happens that the rope is for short periods much more heavily loaded than is usual. The motor must be big enough to respond to this demand; indeed, in all mining work an ample margin of power is necessary.

The only haulage in a colliery in this country by an electric locomotive that I know of was installed at a Yorkshire pit. A rope was laid along the roadway and secured at each end; in front of the train was a special trolley carrying a motor driving a clip pulley. The rope passed round this pulley, and the train was, so to speak, wound along. This system is not likely to be generally adopted.

Another interesting case involving the use of electric locos is at the Greenside Head Lines, Ullswater; a full description of the plant will be found in the *Transactions* of the Federated Institute. In each of these cases the current is taken from overhead conductors by a sliding contact.

There are a large number of collieries using machinery of various kinds that might profitably be driven by motors, and new applications are constantly being made in this direction, such as the replacement of wire rope pumping plant or compressed air machinery, by electric plant.

There is some difficulty in describing what has been done in coal cutting; a considerable amount of work has been done by the Coal Cutting Corporation, but I hear various reports as to the success of the apparatus, and I have never been able to obtain permission to inspect the plant, I am unable to give any details of its performance. There is apparently no doubt that there is a large future for a practical coal cutter, but I think such a machine has yet to be designed; certainly I do not know of one fulfilling all the requirements.

So far I have not alluded to the risk of explosions from gas. This is one of the most important problems of all, and I think that its satisfactory solution will be found in alternating current apparatus, probably di or tri-phase type. So far as I know these have not been used in England, but their simplicity and the absence of brushes and commutators seems to point them out as the ideal mining motor of the future. The difficulty about low starting torque will no doubt be speedily overcome.

Certain so-called safety devices have been devised for continuous current apparatus, the most important of which probably are the steel-clad motor of Mavor & Coulson, in which the whole motor is enclosed in a steel case; the Goolden arrangement in which the armature is enclosed; and the Davis-Stokes method in which the

commutator is enclosed, *i.e.*, the brushes bear on the inner periphery, and the whole enclosed by a revolving ring. The first method seems undoubtedly the best, though in all I fancy the skill of the attendants bears some proportion to the safety.

It is hoped that these notes, which have been hurriedly put together, may be of some service to the members, and that some of the points briefly touched upon may be fully discussed.

NEW PATENTS—1895.

1,915. "An electric safety alarm indicating fog signalling apparatus for preventing accidents on railways at junctions, stations, and level crossings, and for other purposes." A. Tylee, J. Miles, and G. F. Nightingale. Dated January 28th.

1,931. "Making carbons, candles, and pencils for electric lighting and parts of electrical machines or dynamos, such as 'brushes' out of plumbago, graphite, or black lead in its natural state." W. H. Cohen. Dated January 28th.

1,936. "Improvements in or connected with dynamos." J. Graham and H. Chapman. Dated January 28th.

1,940. "An improvement in electrical controlling switches." E. Hopkinson and A. P. Wood. Dated January 28th.

1,949. "A combined mat and electric alarum contact." J. J. Pye. Dated January 28th. (*Complete.*)

1,954. "Improvements in and relating to electrical devices such as electromotors, generators, and the like for use in explosive atmospheres." S. Allingham. Dated January 28th.

1,970. "A method of and apparatus for charging electrical accumulators from alternators and changing into an alternating current the current given by the accumulator cells." J. de Galindez. Dated January 29th.

2,004. "Improvements in electric recording meters and in motors for operating same and for operating the escapement mechanism of clocks or other apparatus requiring a chronometric movement." B. J. B. Mills. (Communicated by C. Wirt, United States.) Dated January 29th.

2,009. "Improvements in holders for electric lamps." W. McKenzie and J. A. Fleming. Dated January 29th.

2,025. "Improvements relating to combined gas and electric light standards." R. W. Braham. Dated January 29th. (*Complete.*)

2,030. "Improved electrical apparatus for indicating and registering the arrivals in velocipede races." G. Besozzi. Dated January 29th.

2,031. "Improved automatic coupling for electro motors." Siemens Bros. & Co., Ltd. (Communicated by Messrs. Siemens and Halske, Germany.) Dated January 29th. (*Complete.*)

2,064. "Improvements in automatic switches and in their use for distribution of electricity." J. Hopkinson. Dated January 29th.

2,077. "Closed conduit electric railway." E. J. Paterson. (Communicated by F. F. Atkinson, United States.) Dated January 30th.

2,080. "A slide rule for magnetic calculations." C. W. Hill. Dated January 30th.

2,100. "Improvements in the construction and method of arrangement and connection of cables and joints for electrical distribution." G. Schultz. Dated January 30th.

2,133. "Improvements in or relating to electric batteries." J. Pogneaux. Dated January 30th.

2,134. "Improvements in or relating to electrical signalling apparatus for preventing collisions between trains." A. B. y Baque. Dated January 30th. (*Complete.*)

2,137. "A permanently and automatically synchronised printing telegraph." C. A. Beck and C. Rock. Dated January 30th.

2,182. "A duplex incandescent electric lamp." G. F. Attree. Dated January 31st.

2,218. "Improvements in or relating to 'Watt-hour' counters for alternating currents of electricity." G. Hummel. Dated January 31st.

2,223. "Improvements in and connected with phonographs." G. McMurdie and C. Daggett. Dated January 31st.

2,228. "An improved combined starting, reversing, and controlling electric switch for operating electric motors." W. A. Clatworthy. Dated January 31st.

2,237. "Improvements in induction coils for use as resistances in electrical plant working with alternating current and with multiphase currents." J. F. Bachmann, J. Liebscher, and A. Vogt. Dated January 31st.

2,250. "Improvements in double and triple pole switches." F. H. Starling. Dated February 1st.

2,277. "Improved method and means of connecting electrical accumulator plates with their conductors." G. Hirschmann. Dated February 1st. (*Complete.*)

2,280. "Improvements in galvanometers." W. O. Smith and G. K. B. Elphinstone. Dated February 1st.

2,288. "Improvements in voltaic batteries." D. G. Fitz-Gerald. Dated February 1st.

2,289. "Apparatus for counting or recording telephonic conversations." J. E. Kingsbury. (Communicated by the Western Electric Company, United States.) Dated February 1st. (*Complete.*)

2,303. "Improvements in and relating to apparatus for lighting and extinguishing electric lamps." L. Hermand. Dated February 1st.

2,308. "Improvements in apparatus for testing magnetic quality in iron." J. A. Ewing. Dated February 2nd.

2,312. "Improvements in apparatus for regulating electrical pressure." J. T. Niblett. Dated February 2nd.

2,333. "Improvements in apparatus for the use of the electric light for photographic purposes." A. G. Adamson. Dated February 2nd. (*Complete.*)

2,341. "Improvements in the driving of electrical or other machines on railway or other vehicles or engines." W. H. Hallsworth. Dated February 2nd.

2,343. "Improvements in or relating to electric incandescent lamps." A. E. Pope. (Communicated by F. R. Pope, Holland.) Dated February 2nd.

2,351. "Vote-recording apparatus." W. Lake. Dated February 2nd.

2,355. "Improvements in magnetic testing apparatus." W. E. Ayrton and T. Mather. Dated February 2nd.

2,366. "Improvements in electro-dynamometers." Siemens Bros. & Co., Limited, and E. F. H. H. Lauckert. Dated February 2nd.

2,373. "Improvements in the socket joints of metallic telegraph poles." Bullers, Limited, and E. J. Chambers. Dated February 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1894.

13,208. "Improvements in field magnets for continuous current dynamos." W. H. Allen, R. W. Allen, and C. C. Hawkins. Dated July 7th. Consists in dividing the poles into more than two entirely separate portions, and the magnetic lines are conveyed into or out of these by portions of the yoke which for the whole or part of their length are also entirely separate. 2 claims.

13,319. "Improvements in electric arc lamps." P. Kirkegaard. Dated July 10th. Has for its object to produce a lamp with a simple and efficient regulating mechanism in which the dash-pot, or other cushioning device to prevent hammering, is dispensed with. 6 claims.

13,333. "Improvements in gas engines." G. C. Marks. (A communication from F. Hirsch, of New York.) Dated July 10th. Consists in the special construction of a gas engine having a duplex open-ended power cylinder with a central gas and firing port, two trunk pistons in said cylinder pivotally connected by rods directly to the ends of two rock levers, the opposite end of said rock levers being connected by pitmans directly to radially opposed cranks upon a common power shaft—all the parts being arranged in a common central plane of action coincident with that of the longitudinal axis of the power cylinder, so that the force of the explosion of gas between the two cylinders is counterbalanced and equally distributed and transmitted to the cranks on the power shaft. 8 claims.

13,410. "Improvements in electrical switches." C. M. Dorman and R. A. Smith. Dated July 11th. Consists of a new arrangement of spring for controlling the position of the lever, also of improved methods of constructing the lever with insulated contact pieces, and also in an improved arrangement of the parts as a whole. 5 claims.

13,523. "Improvements connected with reflectors for electric arc lamps." C. Coerper. Dated July 12th. Relates to constructing reflectors which can be placed either directly over or at some distance above the luminous arc of electric arc lamps for increasing the illuminating effect and diminishing the waste of the carbon points. 2 claims.

13,640. "Improved medico electric pad or bandage." A. Owen. Dated July 14th. The object of this invention is the construction of a medico electric pad which is designed to take the place of poultices, mustard and other plaisters for local applications of heat to the body, limbs, neck, &c., of a patient, the heat being generated and maintained at a constant and uniform temperature by electric current derived from connecting the pad with any source of electricity, for example the socket piece of an incandescent lamp to which it can be readily affixed. 3 claims.

13,765. "Improvements in and relating to electric railways." E. H. Johnson and R. Lundell. Dated July 17th. Relates to improvements in that type of electric railways in which the propelling current is taken from exposed or bared sectional trolley conductors automatically connected, as a car or vehicle proceeds over the route, to an insulated current main in direct circuit connection with a dynamo-electric machine or other source of electrical energy located at a power house. 29 claims.

16,695. "Improvements in electric lighting and extinguishing devices for gas lamps." S. Bruck. Dated September 1st. Claim:—In electric lighting and extinguishing devices for gas lamps simultaneously with the electro-magnetic operation of the gas cock, the concentric arrangement of a hollow bi-polar electro-magnet of large iron contents and with only one bobbin, under utilisation of a part of the gas supply pipe as an inner electro-magnet core, so that the electro-magnet generates induction currents sufficiently strong for the ignition of illuminating gas and at the same time renders the interposition of an induction roller superfluous, substantially as described and shown.